



**How to Manage Your
Woodlot for
Firewood Production
and Sales**



Forestry
Canada

Forêts
Canada

Canada

How to Manage Your Woodlot for Firewood Production and Sales

Sterling Wood Group Inc.
Victoria, B.C.

In association with
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and
Thomson Crerar Ltd.
(Creative & Illustrations)



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Abstract

This report is a companion volume to "Managing Your Woodland: a Non-Forester's Guide", published by Forestry Canada and the British Columbia Ministry of Forests. It focusses on the particular management objective of firewood production from the woodlot. It is intended as a guide, and is laid out in a format which is designed to provide easy reference to the topics associated with firewood production and management. The handbook begins with information about conducting a forest inventory of your property, followed by advice on developing goals, objectives and a management plan for the business. Harvesting, processing, worker safety, and protection of the environment are covered in some detail. Details on firewood marketing and business management, as well as measurement and scaling round out the handbook.

Résumé

Ce compte rendu fait pendant au guide intitulé 'Managing Your Woodland: a Non-Forester's Guide', publié conjointement par Forêts Canada et le Ministère des forêts de la Colombie-Britannique. Ce guide est axé sur la gestion des stocks de bois de chauffage produits dans les terrains boisés et sa présentation a été conçue pour faciliter la consultation dans les domaines associés à la production et à la gestion des stocks de bois de chauffage. Les auteurs traitent d'abord de la façon de faire l'inventaire des essences d'un boisé et de l'établissement d'objectifs et d'un plan de gestion d'une entreprise de bois de chauffage, puis ils passent en revue les divers aspects de la récolte et du débitage, et les impératifs de sécurité industrielle et de protection de l'environnement. Le guide se termine par un examen des pratiques de commercialisation et de gestion d'une entreprise de bois de chauffage, et les techniques de mesure et de pesée du bois de chauffage.

FOREWORD

ENFOR (Energy from the Forest) is a contract research and development (R & D) program managed by Forestry Canada. It is aimed at generating sufficient knowledge and technology to realize a marked increase in the contribution of forest biomass to Canada's energy supply. The program was initiated in 1978 as part of a federal interdepartmental initiative to develop renewable energy sources.

The ENFOR program deals with biomass supply matters such as inventory, growth, harvesting, processing, transportation, environmental impacts, and socioeconomic impacts and constraints. A technical committee oversees the program, developing priorities, assessing proposals, and making recommendations. Approved projects are generally carried out under contract.

General information on the operation of the ENFOR program, including the preparation and submission of R & D proposals, is available upon request from:

The ENFOR Secretariat
Forestry Canada
Ottawa, Ontario
K1A 1G5

1.0 INTRODUCTION

There are a growing number of privately managed woodlots in British Columbia. Both the federal and provincial governments have been actively encouraging management of private forest lands, and the province has been making Crown land available to eligible people for woodlot use. One of the most popular uses of these small parcels of forest land is the production of firewood. It lends itself to family employment and can provide a good family income especially if combined with farming or other land-based work. This handbook sets out to give some guidance toward the successful management of a woodlot for firewood production. It points out the pitfalls, and the various regulations and legal obligations, and the management responsibilities that go with operating a woodlot. It also provides a guide to marketing firewood and to the costs involved in producing the firewood, so that the woodlot owner can get an idea of realistic expectations. This handbook is a companion to "Managing Your Woodland: a Non-Forester's Guide" published by Forestry Canada and the B.C. Ministry of Forests. That publication deals with many of the aspects of managing a woodlot and is a very useful tool for those unfamiliar with forestry practices. While there are some overlaps, this handbook focuses on the particular management objective of firewood production from the woodlot.

Other publications can also shed further light on the intricacies of various aspects of forest management. A list of these is provided in a bibliography section at the end of this handbook. In addition, agencies such as Forestry Canada and the B.C. Forest Service as well as the Universities and Colleges willingly give advice when asked.

This handbook is intended as a guide and is laid out in a format which is designed to provide easy reference to the topics associated with firewood production and management. It tries to avoid details and explanations of technical matters. Instead, it seeks to provide a general insight into the techniques, problems and opportunities that a manager will likely encounter.

The handbook starts out with information about conducting a forest inventory. After all, this is the basic building block of information from which all planning and decision making will be made.

The next logical step after you know what resources you have is to set goals and objectives for the firewood business, and then prepare a management plan which will lead you toward achieving those goals. Chapter 3 deals with these aspects.

Harvesting of the firewood crop will be a central activity to the enterprise. The handbook goes into some detail about this aspect and includes a section on horse logging, which is a method well suited to firewood production from small woodlots.

A chapter is devoted to the processing of firewood. The final product may take several forms—from logs decked at a landing to dry, split firewood ready for the stove. This chapter discusses the processing procedures and seasoning requirements.

Many of the activities for producing firewood are dangerous, especially if you are unfamiliar with the equipment. Safety is very important and a chapter is devoted to this topic to provide a rudimentary guide to the precautions that can be taken to lessen the risk of injury.

As well as your own health and that of others working on the woodlot, it is important to safeguard the health of the forest. A section on forest protection is provided and in this there are descriptions of the hazards from fire, insects and disease, as well as precautions to be taken to lessen these risks.

There is advice on marketing the firewood product. The woodlot owner must find out where his markets are and build up order files so that he can carry on his business in an orderly fashion.

Finally, the handbook attempts to lead the woodlot owner through the obligations imposed by licences, forms, reports and taxes that are associated with this enterprise. They need not be very onerous if the operator is aware and prepared for them.

2.0 INVENTORY

2.1 Overview

This section outlines the inventory information you must collect to allow you to manage all or portions of your woodlot for firewood production.

The basic objective is to know what you have on your land; the timber resource, your land's capabilities and the amount and value of other resources. The determination of these inventories can be as complex as you want or it can be very simple, but some minimum inventory is essential to any woodlot management.

In its simplest form your inventory must at least provide a classification of your forest into the different forest growth types and a map of your property defining the classification. Reference material to assist in measuring, mapping and classifying your forest resources follows at the end of this handbook. The procedures to be used to gather inventory data are well explained in "Managing your Woodland", available from Forestry Canada, and are not repeated here.

2.2 Classifying the Forest

Classification of forests within British Columbia has been defined by foresters to follow a set procedure and a number of rules and conventions have been adopted.

Each distinctive growth type is classified by the following factors, each of which affects the value of your timber assets. Each of these growth types is outlined on a map and given a descriptive label which may include all or some of these factors. For want of a better word these distinctive types or "islands" are referred to as "polygons" when drawn on a map.

Tree Species	Should be identified in order of prominence using conventional symbols.
Age Class	In 20 year age classes.
Height class	In 9 m (30 ft) intervals.
Stand density	Using a code which shows the number of trees per hectare.
Productivity	A measure of the capability of the soil to produce forests. (Often called site class)
Crown Closure	the proportion of total area covered by the forest canopy.

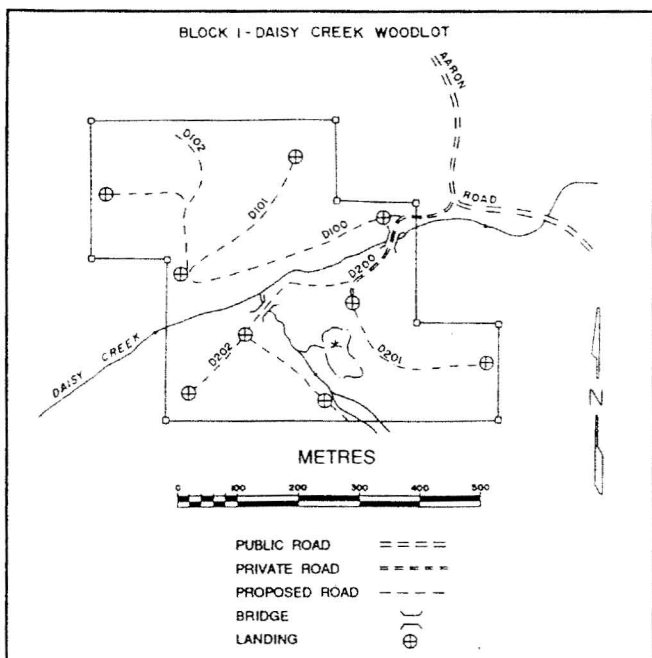
Appendix I shows the standard symbols and conventions used in forest classification.

There are many other inventory classifications that may be identified by convention or code. Examples are:

- history of disturbance by type and time; (eg. logging or fire)
- environmental sensitivity; (eg. fragile soils or critical wildlife habitat)

- areas that are unharvestable and must be removed from inventory for a variety of reasons: (eg. too rocky or steep)
- ecological classification. (showing the biological, soil and climate factors present)

The map you prepare for your woodlot will show the boundaries of your property; the major features such as creeks, lakes, swamps, contours, roads, bridges, buildings and other important structures as well as the forest types.



Block 1 - Daisy Creek Woodlot (sample map)

The map scale used will depend upon the size and complexity of the woodlot. For small woodlots a map size of 1:5000 is suggested. Map scale of 1:5000 means that 1 cm on the map is equal to 5000 cm on the ground (1 cm on map = 50 metres on the ground)

2.3 Calculating Your Inventory

After you have classified your forest and drawn the types on a map you can start calculating your forest inventory. First of all, the areas for each forest type should be measured by any one of a number of different ways:

by counting dots on a grid; by using a planimeter or by using a computer form of planimeter that measures areas through a process called digitizing.

Whichever means is used it is wise to record the area for each type and then check that the sum of all type areas equals the total area of the woodlot.

The report that you produce in this process will be the start of your forest inventory. It is sometimes also referred to as a map attribute list. The attribute list for the map illustrated would show as follows: (see Appendix I for a description of each of the code letters and numbers).

ATTRIBUTE LIST – DAISY CREEK WOODLOT BLOCK 1								
Area No.	Area ha.	Species	Age Class	Height Class	Stocking Class	Site Class	Crown Closure	Description Soil/Topography ¹
1	2.9	FD	3	3	0	M	7	Loam/Gravel – slope < 25%
2	3.9	FPI	4	3	0	M	7	Gravel – flat ground on bench
3	9.5	DMbF	3	3	0	G	7	Loam – Slope flat to 15%
4	2.7	FD	3	3	0	M	7	Loam/gravel – Slope < 25%
5	3.9	F	4	4	0	M	6	Gravel – Slope 20-45%
6	0.5	F	9	4	1	M	6	Gravel/Rock – Slope > 45%
7	0.4	N.P.						Swamp
Total	23.8							

By way of explanation of the attribute list, area No. 1 is 2.9 hectares in size. It supports a stand of mainly Douglas-fir and alder. The age of the stand (Class 3) is between 41 and 60 years, the average height of the dominant trees (Class 3) is between 19.5 and 28.4 metres (64 to 93 feet). Stocking class 0 means that the stand is still immature (generally under 120 years), the site class is medium and the crown closure is between 66% and 75%, meaning that the tree crowns have joined together to intercept between 66% and 75% of the light.

The calculation or estimate of volumes is the next step in the inventory process. Various levels of sophistication are available but you will need someone with timber cruising experience to help with most of them unless you happen to know how to do it yourself. Volume estimate procedures can involve sampling of the forest types and use of tables produced by the Forest Service giving the volume at any given age

according to site and species, and adjusted for volume losses for decay, etc.

At the outset this may be more complicated than is necessary for your woodlot. If you want an accurate volume estimate you can hire a forestry consultant to do it for you, otherwise there are tables showing firewood yields in cords per hectare for the major forest types in British Columbia. These tables are reproduced in Appendix II and are probably adequate for most purposes. You can adjust the tables to fit your experience as time goes on.

Use the tables to assign volumes by species to the various growth types on your woodlot, add up the totals and divide the volume by the area to give the volume per hectare for each type as is shown in the following table.

VOLUME SUMMARY - DAISY CREEK WOODLOT BLOCK 1									
VOLUME IN M³									
Type No.	Type description	Area ha.	Fir	Cedar	Pine PI	Alder	Maple	TOTAL	Vol. ha
1	FD330M7	2.9	551	58	0	203	0	812	280
2	FPL430M7	3.9	702	0	234	0	0	936	240
3	DMbF330G7	9.5	570	190	0	1805	665	3230	340
4	FD330M7	2.7	513	54	0	189	0	756	280
5	F440M6	3.9	1326	156	0	156	0	1638	420
6	F941M6	0.5	150	0	0	0	0	150	300
7	NP	0.4	0	0	0	0	0	0	0
Total		23.8	3662	458	234	2353	665	7372	310

Firewood is produced and marketed in cords, or ricks, or face cords, or some other natural unit. Foresters measure yields and volumes of firewood and other forest products in cubic metres per hectare. For a woodlot owner it is absolutely necessary to know the relationship between the measurements.

While a cubic metre is a precise measurement, the volume of cut wood or of a standing tree cannot be precisely determined in a practical manner. Some useful conversion factors are set out in the following illustration:

CONVERSION FACTORS

1 cord = 85 cu. ft. solid wood and bark
= 2.4 m³ of solid wood and bark
= 128 cu. ft. of stacked wood, bark and air
= 3.6 m³ of stacked wood, bark and air

One hectare = 2.47 acres

1 cord = stacked pile of wood, bark and air that is 4 feet high, 4 feet wide and 8 feet long.

Rule of thumb:

A 3/4 ton pick-up truck will hold 3/4 of a cord stacked or half a cord if the pieces are thrown in at random.

Other measurement information useful in woodlot management is detailed in Appendix VIII in both metric and imperial equivalents.

3.0 FOREST MANAGEMENT

Forest Management consists of planning and working with a number of important elements. In point form these elements include the following.

- 1) Describe your forest showing:
 - inventory
 - a list of forest types (attribute list)
 - description of resources including those other than timber
- 2) Establish your goals and objectives
- 3) Establish your plans in terms of areas and time for:
 - access
 - forestry
 - other resources

3.1 Description

Your inventory and timber type attribute list, as developed following the guidance in chapter 2 will be the basis of your management plan. A thorough understanding of each part of your forest is essential to provide a realistic practical management and operating plan.

The areas, volumes, and yields must be examined and the numbers will help you to determine realistic goals and objectives.

Volumes and areas currently ready for harvesting will be identified from the attribute list and the volume table for the woodlot.

The other resource values will also be set out in the inventory report either by description or in terms of environmental sensitivity. These values and the limitations or expectations set out in your goals and objectives will help determine the areas for and timing of harvest and forestry activities.

3.2 Management Goals

The concept of operating your woodlot for firewood production was introduced in Chapter 1. There is no doubt that firewood is a logical and competitive forest product for some woodlots (certainly for some forest types or portions of the woodlot), and firewood will definitely develop as a byproduct of silviculture and sawlog harvesting activities.

In its most extensive situation your major goal may be to manage your woodlot for maximum revenue through firewood production. The other goals that would logically follow to support the major goal might be:

- to maintain the productivity of your woodlot;
- to provide employment to yourself, family and others;
- to protect, manage and gain from other resource values;
- to qualify and gain from having your woodlot classed as "Managed Forest Land" by the B.C. Assessment Authority. This may provide you with the advantage of lower land taxes.

If your choice is to manage your woodlot for firewood production then

specific management objectives and a management plan must be produced.

3.3 Planning

The selection of areas and timing of activity will form the backbone of your management plans. There are several degrees of planning which range from the long term (20 years or more) down to the more detailed month by month plan which becomes the main operating tool.

EXAMPLES

NAME OF PLAN	PERIOD OF TIME	AMOUNT OF DETAIL
Management	20 years	General Description giving total volumes, distances. Annual cuts related to goals and objectives.
Development	5 years	Specific forest types with areas and road access shown. Harvest volumes by species & products. Forestry activities are shown by activity & costs.
Annual plan (budget)	1 year	Specific plan for upcoming year in detail by month with projection of revenues and costs.

For more detail on the development and annual Plan as they might apply to our Daisy Creek Woodlot see Appendix III.

3.4 Firewood Management

The management of your woodlot for firewood production must be based on analysis of the woodlot's capability and earning potential for firewood as opposed to its potential for other forest products or its other values. The economics and return will be discussed in detail in chapters 4 and 5 on firewood harvesting and processing and in chapters 8 and 9 on marketing and business management.

The gross revenue for firewood per meter of wood and bark varies throughout the province and is dependant on the ease of access to firewood supplies. Like most commodities the value is closely linked to the demand and the supply. In many rural communities firewood supplies are plentiful and easily accessible. The users of firewood in these communities usually have their own equipment and vehicles and generally have the skill, fortitude and energy to handle their own firewood needs. The Forest Service willingly gives out firewood cutting permits and directs people where they can cut. The mid sized and large communities provide a much more varied as well as a much larger

market. The demand is high and the ready supply is low. This leads to a relatively high market value per meter for firewood compared to other forest products. The relative scale of firewood value compared to the value of the same size of tree as a conventional forest product is shown in the following table.

Product	Medium Sized City (15000 - 75000)	Large city (>75000)
Firewood-delivered (from trees 20-30 cm diam)	1.8	2.4
Deciduous-Pulpwood 20-30 cm diam.	1	1
Coniferous - Pulpwood	1.7	1.7

Note: Prices vary with time and geographic location.

Sawlogs over 15cm top & 20cm butt for Coniferous & over 20cm top for Deciduous will gather a premium sale value. (Average sale value is reflected in the table)

Based upon the table of product values it would be clearly economic to manage for firewood in most circumstances. The opposite side of the coin shows, however, that the cost to deliver firewood to market is somewhat higher than for the other forest products because of the extra handling firewood demands with the cutting, splitting, loading and unloading at market. Justification for firewood management can also be rationalized if the woodlot provides family employment and income.

Another factor that must be considered in determining whether to manage for firewood or for other forest products is the period of time necessary to recover these forest products where the product value exceeds that of firewood. In reality many of the decisions to be made will relate to the management goals you have set for your woodlot and not to the net product values.



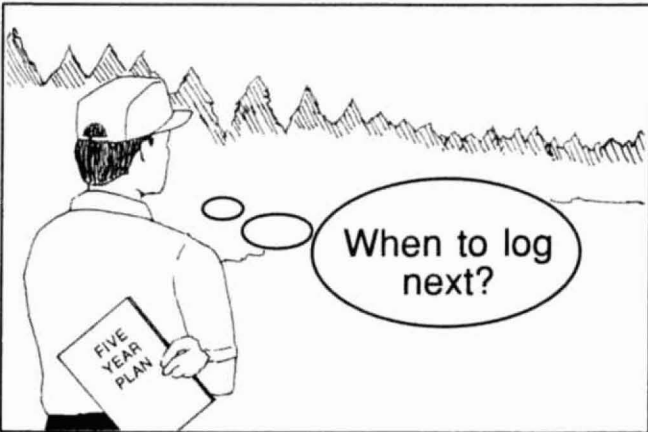
The management of your woodlot for firewood production is based on the woodlot's earning potential.

4.0 FIREWOOD HARVEST

4.1 Source of Wood

Harvesting can proceed when the woodlot has a sufficient number of stems of a size that can be cut into firewood. As trees grow faster when they are young the best return (considering the woodlot as an investment) is usually obtained by harvesting firewood when it reaches saleable size rather than delaying harvest to get larger trees.

The frequency of harvest and the volume cut and removed depends on many factors. Especially important are the size of the woodlot, the method of harvest, the ability of the site to grow trees, the stocking (number of stems) and the number of stems that have reached harvest size. Most larger woodlots, assuming forest management and sustained yield production, can be harvested annually; smaller woodlots are sometimes harvested on a periodic basis—say every five years.



The frequency of harvest and the volume cut depends on many factors (eg., size of woodlot, method of harvest, etc.).

Most harvesting for firewood can be done on an annual basis. Note, however, that small harvests for only a brief period during the year may not justify the ownership or rental of harvesting equipment. However, in some situations, idle farm equipment and labor can be used to advantage for small annual harvests to support farm income.

Your 5-year development plan will identify the areas and the activity you intend for each year. For an example, please refer to the Daisy Creek Woodlot development and annual plans shown in Appendix III to this report.

The annual budget or operating plan defines much more closely, and

sets out by season (and month), all of the work to be done. Your plan can be much more detailed in practice than the illustration shows.

Each activity will have some impact on the volume and type of product available for marketing and the annual plan will assist you to complete the business plan for the woodlot.

Firewood will be developed from the following activities:

- (i) Access road right-of-way
- (ii) Silvicultural and Stand tending
 - Commercial thinning and some spacing
 - Rehabilitation of areas of brush and weed species
- (iii) Harvesting
 - (a) from stands designated for firewood production using
 - selection cutting
 - shelterwood system
 - clearcut
 - (b) as by-products of sawlog harvest
 - tops and broken logs
 - rotten and deformed trees
 - undersized trees

4.2 Access

Good access is required throughout your woodlot for all of your activities. Roads are required for equipment movement, for forwarding or moving trees and logs, and for access to carry out stand treatment, forest protection and recreational activities.

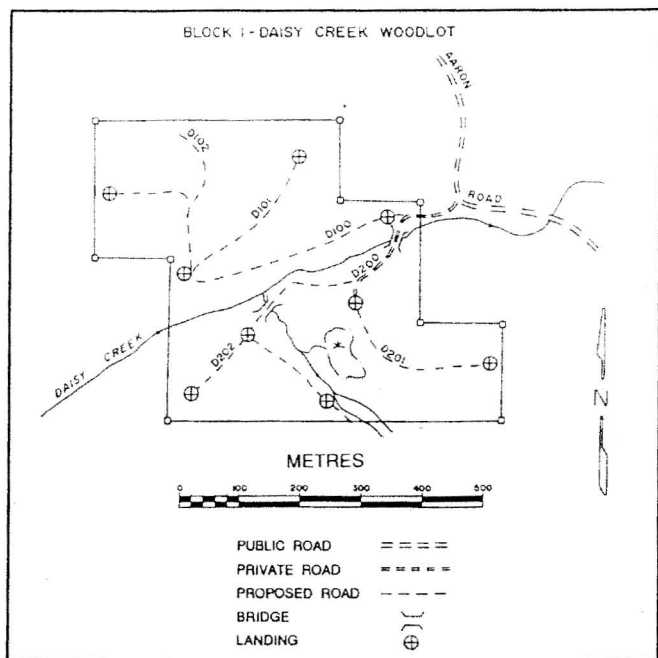
Some roads are simply access trails for people, some will be classed as skid trails and others will be used for equipment or vehicle travel. These latter roads may be all-season or seasonal. The seasonal roads may be snow roads used only in the winter time or dirt roads only useable during dry periods.

Ideally your woodlot will have all of the main access roads maintained in permanent condition. All access routes should be shown on your operating map with different road classes shown by differing symbols.

The location of access routes and their spacing will be determined by the topography of your woodlot, the type of equipment used and the silvicultural systems employed. Landings or processing sites for firewood are also an important aspect of planning firewood harvest.

The following map shows the access roads and landings necessary to develop the Daisy Creek Woodlot for firewood production.

Some dry sites will permit vehicle access directly into the stand for firewood harvest but the effects of soil compaction and degradation must also be considered. Road construction requirements for efficient operation and environmental protection are reviewed in other sections of this handbook.



Access roads are shown on the woodlot map.

4.3 Silviculture Systems for Firewood Production

4.3.1 Selection Cutting

In this system selected larger trees or undesirable diseased trees are removed from an uneven aged forest. Smaller adjacent trees are then free to grow to a larger size, thus filling the gap or replacing the volume removed. The key to a successful selection forest is in having sufficient stocking of all sizes or ages of trees. As more growing space has been provided after a harvest, immature trees will move up to become saplings. In situations where natural regeneration is sparse or is slow to occur, supplemental planting can be used.

Leaving openings without seedlings can decrease the future productivity of the woodlot and sometimes invites the establishment of brush or undesirable species. Selection harvesting works best for species that tolerate shade. The table shown in Appendix IV sets out the major management and silviculture considerations for B.C. tree species including their shade tolerance.

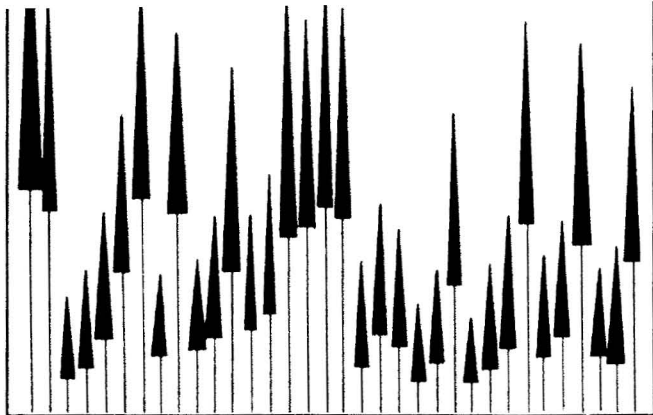


Diagram of a forest suitable for the selection system.

In planning a selection harvest one must look at the inventory classification and forest management map of the woodlot. The growth types or polygons with the older or larger trees are usually considered first. The idea is to harvest these areas until other areas are ready for harvest. Harvesting continues progressively throughout all areas suitable for this system. Periodic checks of the earlier selection cuts are used to gauge when re-cutting is feasible and hence whether the area being harvested each year is too little or too much. Ideally one wants to be able to return to the first area, after harvesting in all the other areas, when it is just ready for harvesting again.

In selection cutting the harvest cycle (the elapsed time until the area can be cut again) varies with the quality of the site and the speed with which the species on the area grows. Note also that logging costs increase as less volume is removed. Hence, the shorter the harvest cycle, the more costly the logging. On the other hand long cycles favor large trees becoming larger to the extent that even tolerant smaller trees will slow in growth from lack of sunlight. This means that the in-growth necessary to the selection system is at risk, and this should be avoided.

A conservative starting cycle of about 10 years is recommended. As experience is gained with the particular woodlot situation the cycle may be increased or decreased.

How many stems to harvest (or how many cords to remove) is the next important consideration. The wrong approach is to remove all trees "large enough" to make firewood. The proper approach is to evaluate the areas in terms of stocking and more particularly stocking classes (i.e. mature or firewood size, immature, saplings and seedlings).

Note that there should be more immature than mature, more saplings than immature, and more seedlings than saplings. It is desirable to keep this balance. The system is kept in balance by harvesting more or less of the largest trees (or in some situations by planting more seedlings). If, for instance, one notes that there are many more immature than mature trees, some of the immature that are barely firewood size should be harvested. Conversely, if there are many mature and few immature trees, some of the smaller mature trees should be left for the next cutting cycle. If it is noticeable that regeneration is not occurring and many open spaces are appearing, supplemental planting may be necessary to maintain the seedling stocking class. Other treatments to assist in keeping the selection system in balance follow:

PROBLEM	TREATMENT
Too many seedlings	brush out smaller/poor seedlings
Too few saplings	clean out around larger seedlings to promote growth or spot plant large seedlings
Too many saplings	space out (cut) shorter or poorer saplings
Too few immature	clean out around larger saplings to promote growth (or leave some smaller mature)
Too many immature	harvest any that are usable with mature or, if small in size, thin-out (cut) shorter or poorer stems

The volumes that should be harvested annually per unit of area using the selection system are difficult to predict without considerable plot sampling in the woodlot. A very rough estimate may be obtained by referring to the yield tables for major species in Appendix II. If a stand can be cut for firewood at say 60 years and the cutting cycle is 10 years, the volume between age 50 and 60 approximates a heavy cut. A more moderate cut estimate is obtained by dividing the number of cords shown at a particular age by that age and multiplying by the cutting cycle (i.e. 10).

CALCULATION

$$\frac{\text{Yield at age 80} \times \text{Cutting cycle} \times \text{Area}}{\text{Age}}$$

$$\frac{225 \times 10 \times 3}{80}$$

= 84 cords every 10 years

= Annual cut of 8.4 cords from this 3 hectare area.

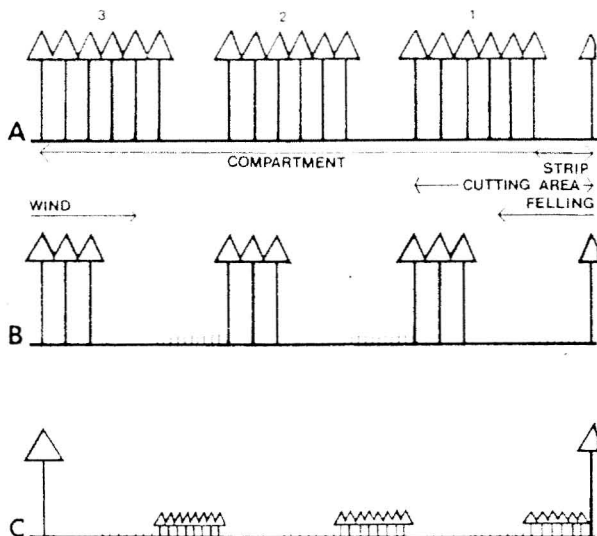
4.3.2 Small Patch Clear-Cutting or Shelterwood

These two systems have similar characteristics. They result in patches of larger trees being removed and the resulting open areas are reforested by natural regeneration or by planting.

This system is appropriate for species that do not tolerate shade (i.e. shade intolerant species). The patches tend to be even-aged; that is to say, they are covered with either seedlings, or saplings, or immature, or mature stand classes.

In order to be successful, the system requires that regeneration be planned in advance of logging. Small areas will seed-in from adjacent stands provided seed producing trees are left nearby. Leaving openings without seedlings is usually an invitation for brush, weeds or undesirable species to become established. Planting in recent years has become increasingly popular as it is usually more successful in rapidly establishing the new stand.

THE STRIP SHELTERWOOD SYSTEM



- A THE FIRST STRIP IN EACH CUTTING AREA HAS BEEN CLEAR-CUT TO ALLOW FOR SEEDING-IN.
- B THE SECOND STRIP HAS BEEN CLEAR-CUT IN EACH CUTTING AREA AFTER A NEW CROP HAS BEEN ESTABLISHED ON THE FIRST STRIP.
- C THE THIRD STRIP HAS BEEN CLEAR-CUT IN EACH CUTTING AREA AFTER A NEW CROP HAS BEEN ESTABLISHED IN THE SECOND STRIP.

Diagram showing steps in cutting a compartment within 15 years: 5 years between cuts (regeneration period).

smaller pieces and scatter them widely.

In planning the harvest sequence using these systems, one again looks at the inventory classification and forest management map of the woodlot. Areas with mature trees (suitable for firewood) are given priority. The idea is to harvest these areas one at a time until other areas have grown to harvestable size. Ideally, if the rotation is 50 years (the time from regeneration to maturity), then 1/50th of the woodlot would be harvested every year. In practice, however, there is usually more area in some age classes than in others. The procedure used to bring the system into balance (i.e., move to sustained yield) is to cut slightly more or less area each year depending on the mature area relative to immature. In some situations harvesting may have to be delayed for one or two years. Stand tending can also be used to bring the system into better balance. If, for instance, it is obvious too much area has sapling sized trees, part of the area could be spaced (poorer quality shorter saplings are cut out leaving a select number of evenly spaced taller saplings). The spaced area will grow faster and in future years provide a stand ready to harvest earlier than for unspaced stands.

Each woodlot will be unique, but the best situations occur with a wide diversity of age classes in patches throughout the woodlot. As age relates to height which is easily noticeable, the previously mentioned classes of seedling, sapling, immature and mature can be further subdivided. In essence, you want a great variety of patches that are just a few years different in age or in height. Once this has been attained the harvest process becomes one of cutting and regenerating the patches as they reach maturity.

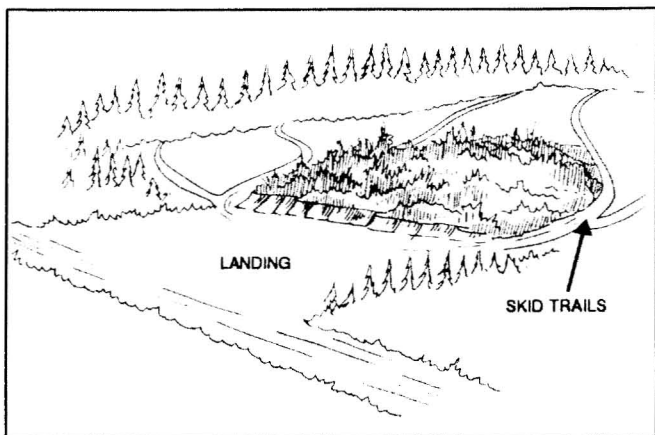
Experience will help in estimating the volume to be harvested annually (or periodically). Another estimate can be obtained from the yield tables and the rotations shown in Appendix II. The table gives the estimated rotation lengths anticipated to produce firewood. The yield table gives the estimated cords of firewood per hectare that will be produced at that age or over that length of rotation.

Provided some areas of the woodlot are mature or the trees are big enough to cut for firewood, initial harvesting can be based on the designated rotation age. If the rotation is estimated to be 50 years, then cutting 1/50 of the area annually is a good starting target. As previously discussed, this is then adjusted up or down depending on the balance of areas by age classes for the entire woodlot.

There are many sources of reference material to assist in planning, estimating yield projections, and scheduling silviculture activities. References are provided in the bibliography section of this handbook.

4.4 Access Roads and Landings

The construction of access roads, skid trails and landings must be carried out with great care to avoid problems of soil compaction degradation or erosion.



Skid trails should approach the landing from either end and take advantage of flatter ground to keep cut banks low.

More environmental damage can occur through poor road planning and construction than any other activity. The following are the most important considerations that will affect the costs of construction and the impact on the environment:

SEASON OF CONSTRUCTION

- avoid wet periods when water table is high and flash floods are possible

EQUIPMENT USED

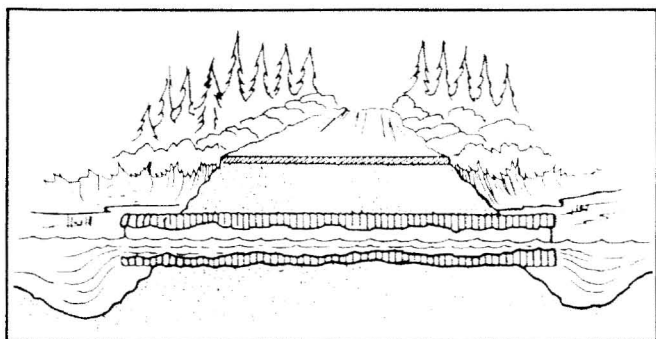
- backhoes or crawler tractors are the most efficient tools for building new or rehabilitating old access roads

DRAINAGE REQUIREMENTS

- the construction of roadside ditches lowers the water table and directs the surface drainage to predetermined locations or cross drains. Cross drains are important to ensure no major change in the natural drainage pattern is caused by construction

drainage, great care must be taken to consider fish and recreational values.

References to assist you in planning, constructing and maintaining your roads and access skid trails are set out in the bibliography at the end of this handbook.

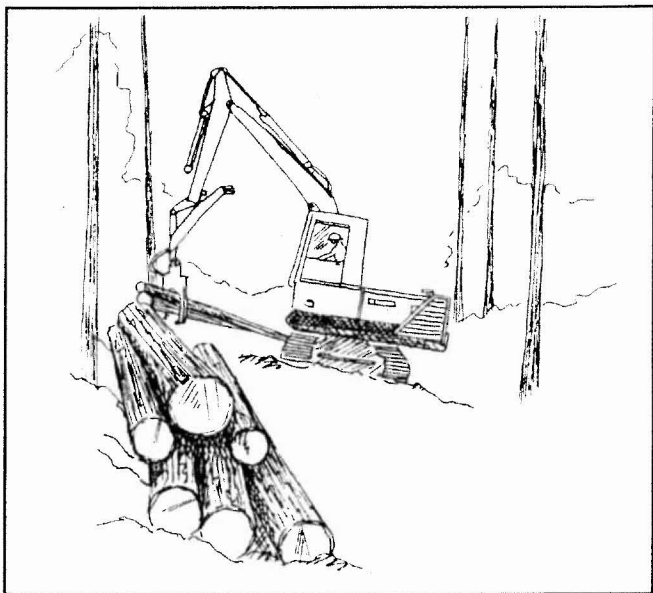


A general rule of thumb is to bury the culvert by 1.2 times its diameter

Landings will usually be necessary for the handling and processing of firewood. If the wood is cut to length in the woods and delivery is by pickup or truck that can move throughout the stand then landing construction will be minimal.

Normally logs or trees will be forwarded to a central point and there manufactured to firewood length, split, loaded onto trucks and delivered to the customer. The landing size will be determined by the volume handled and the equipment used. Two important considerations in selecting the landing site and determining its size are:

- Select higher ground to avoid drainage or moisture problems
- Ensure the landing is large enough to avoid safety problems to people, animals or equipment.



Landings are necessary for the handling and processing of firewood.

Provision must be made for "housekeeping" at each landing. Often there is a considerable amount of debris developed even if branches and tops are left where the tree was cut. Make sure you have room to pile the debris away from the main work area. Later it can be scattered or burned.

4.5 Harvesting

Woodlot operations vary greatly in size and production levels, but in British Columbia they are generally a relatively small scale operation often suited to family management in much the same way as are many farms. In this situation the falling process will be assumed as hand falling using power saw. The forwarding phase can be assumed to be handled by one or more machines or by horse. The choice of equipment or animal must be based on such factors as weather, topography, timber size and economics.

Tractor	All	10	40	1.0-7.0	mod-gen	solid	250
Winch							
high lead	Clear-cut	100	100	1.0-6.0	any	any	250
sky line	All	100	100	1.0-6.0	any	any	300

* Turn size varies with equipment. Use of 2 horses doubles turn size.
Table showing the limitations and capabilities for the major systems.

There is tremendous scope and variation in the methods and equipment that can be used for bringing the firewood logs into the landing. Whether you do it yourself, with your family or whether you choose to carry out all or some phases by contract is a personal or business decision to be based on your capabilities, equipment and goals. If you decide to contract out any work then it will be necessary to draw up a contract which protects your interests.

4.6 Contracting

As a woodlot owner you will be required to reach agreement with contractors and others on work that you want them to carry out. Undoubtedly, if there are complexities in your agreement with a contractor you will want to involve a lawyer to assist you. Even if you do not find a lawyer necessary you should understand something of the Law and Contractual agreements.

LAW

- by definition, is simply a code of conduct to govern relationships between people. There are two main branches, criminal and civil. Within the Civil Law branch there are two sub-branches—Contract and Tort.

TORT

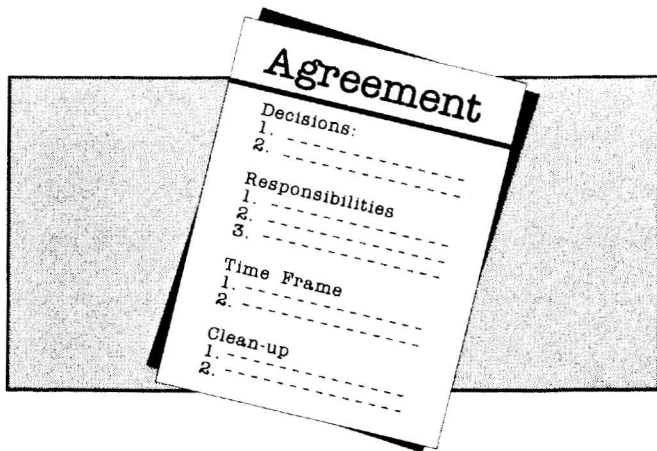
- concerns relationships between individuals in general under the standards of behavior established by law over the years—mainly in the form of binding decisions from courts.

CONTRACT

- concerns the special relationship between two or more parties, in voluntary agreement, to govern some specific task or project

AN AGREEMENT

- does not have to be written down to be a contract in the eyes of the law. If, however, the agreement concerns an interest in land, there must be written and signed evidence of the terms of the agreement.



It is usually wise to put your agreement with a contractor into writing. This way there is at least a form of checklist that the major potential problems have been reviewed and agreed upon.

Some of the important elements to agree upon are:

- Work to be done.
- Timing of the work.
- Payment amount, holdback, and payment schedule.
- Measurement of progress or results.
- Who will represent the owner.
- Obligations of the contractor:
 - to have Workers Compensation coverage.
 - to accept statutory obligations such as pollution, fisheries, noise, employment standards.
 - to carry insurance to protect you in the event of fire, damage or personal liability.



Trees can be harvested at any season of the year. There are a number of important factors that determine the season of activity for a given stand of timber or a specific system of harvesting.

Selection systems or thinning activities should not be carried out during the spring season when sap is flowing freely. Bark damage to residual trees will be a certainty if rubber-tired skidders or tractors are used for yarding during this time. Bark damage will provide an opportunity for further damage by disease or insects. Selection logging with horses can sometimes be carried out during the period when tree sap is running and as long as care is taken in the layout of trails and with the falling direction.

- soil moisture content is also a factor affecting season of harvesting. Many soils will not support yarding equipment while saturated. If this is the case or if haul roads will not support vehicles during wet periods then harvesting these areas must be scheduled for dry or frozen seasons.
- the use of cable methods is a wise means of carrying out harvesting of wet areas as the dragging or aerial lift of trees or logs through the wet ground usually does not harm the soils. The cable yarding process in fact often helps to provide flat wet areas with some drainage that may increase soil productivity for the next crop.
- apart from the obvious problems of getting equipment stuck in mud or wet ground and the lower productivity caused by traction

problems, the major concern about operating in areas with excessive soil moisture is damage to the productive capability of your woodlot. Compaction of the soil is a real hazard and it may take many years before the productivity is restored.

4.8 Forwarding

Whether harvested by selection or clear-cutting the movement of trees or logs to a road will probably be necessary. This process is known as yarding or forwarding. The table in section 4.5 shows a broad range of the methods and their limitations. If any thinnings or selection harvesting is carried out then a fairly small tractor or skidder (rubber tired or cleated) will be better than a large machine with 2.5 to 3.0m width.

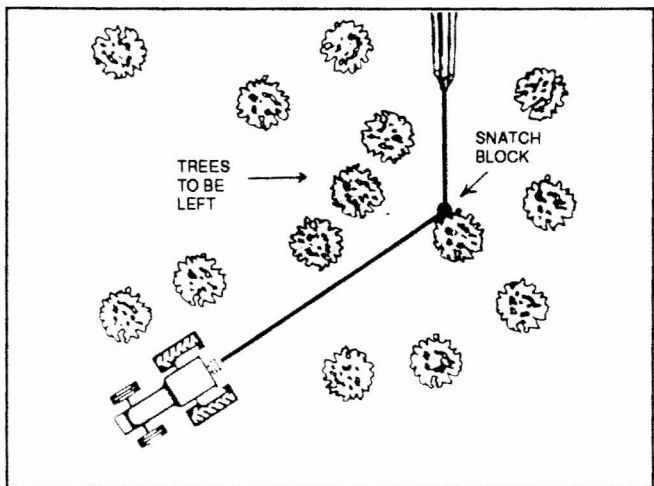
The ideal machine would be a skidder or tractor with a cable winch that can be used for "high lead" yarding. This would require a "double-drum" winch or one that can be used with both main and haulback line (power drums for inhaul and outhaul cables). There are so many variations in equipment size and configuration that one woodlot owner could never own all of the types of equipment best suited for each area of forest. This is the main reason that contracting certain logging phases is necessary and popular.

The Forest Engineering Research Institute of Canada (FERIC) has conducted trials and studies of most of the equipment used in woodlot harvesting throughout Canada. All of their publications are available through subscription and lists of publications are available from their offices at the UBC campus in Vancouver. References and addresses are set out in the bibliography. Reports of harvesting equipment and methods are also available from other sources which are also listed in the bibliography.

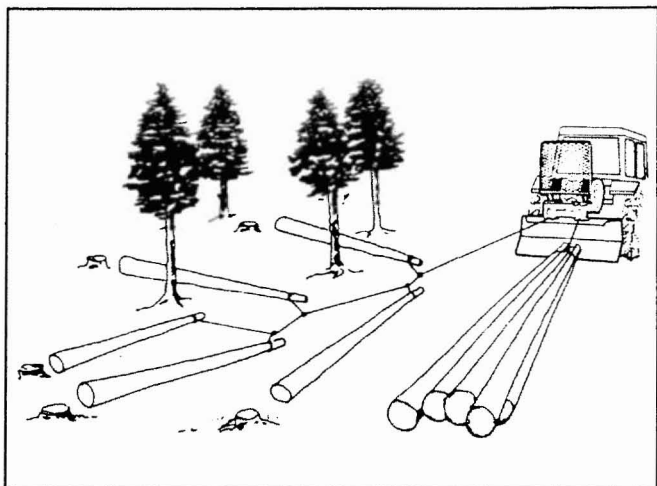
The following illustrations show conceptually a number of forwarding systems:



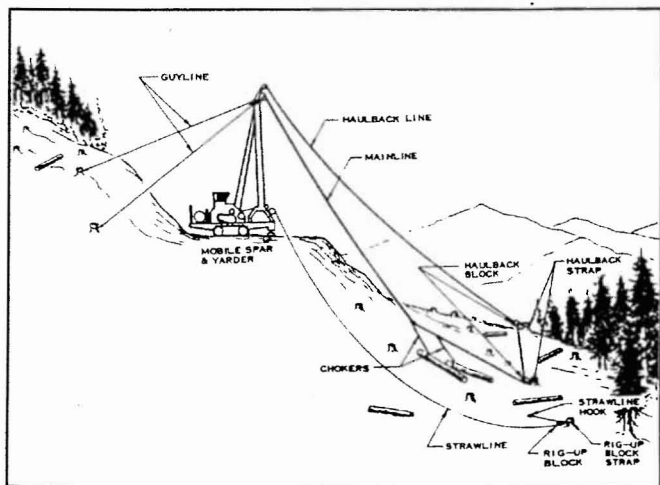
Farm tractor with winch—Clearcut



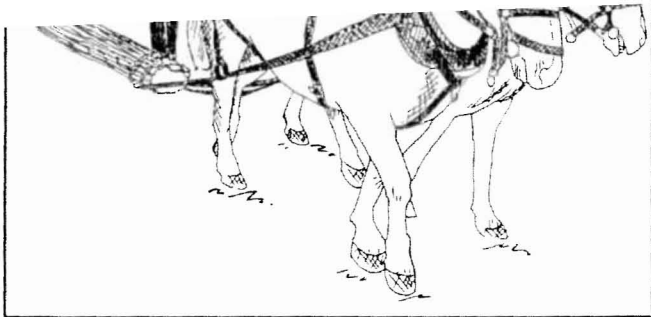
Small Skidder c/w winch—Selection



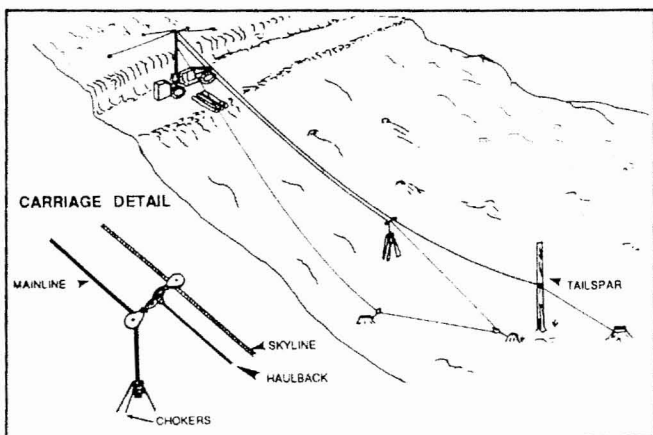
Small tractor c/w winch—Clearcut



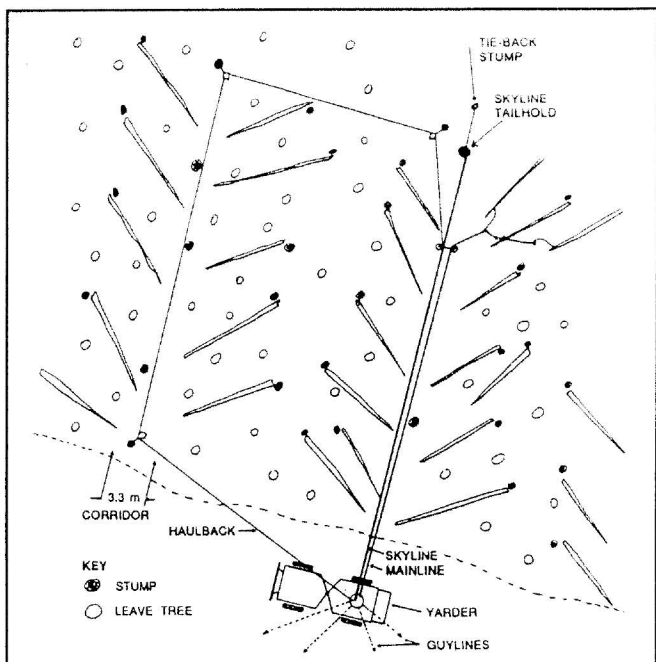
High lead system—Clearcut



Horse Logging



Skyline System—Clearcut



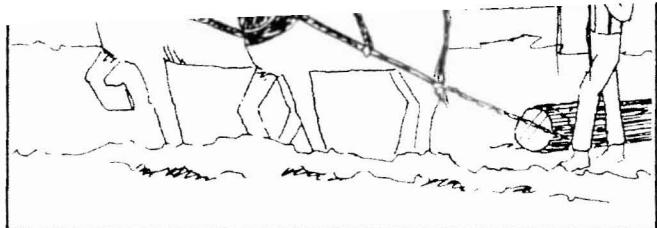
Skyline System—Selection

4.9 Horse Logging

The use of a draft horse or a team of horses is logical for a landowner operating a family farm as well as a woodlot. Make no mistake, you should not venture into the draft horse business unless you are prepared to spend every day of the year on your business. If you are not using the horse for farming or logging it will still require attention for feeding, water, exercise and health care. Similarly there will be daily chores in the barn, and on the harness and gear whether you are logging or not.

The draft horse, on the other hand is ideally suited to skidding firewood sized logs and trees to landings. The horse has low impact on the land as the need for neat and tidy skid trails disciplines you as operator to trim your trees carefully and keep your stumps low. The limitations of the horse forces you to only use dry weather or solid ground and therefore only minimum disturbance or degradation of forest soils will occur.

As well as being demanding of your time, horse logging is hard physical work.



Landowners who operate a family operated woodlot may find using draft horses to be a sensible choice.

4.9.1 Getting Started

There are a number of factors to consider once you have decided to embark on a horse logging venture. If you already have farm animals then you probably have the basic infrastructure which includes a barn, a corral and pasture as well as hay and grain storage and water supply. All of these must be available the day you get your horse.

There are many breeds of draft horses and your choice will probably depend upon what animals are available, the price and the suitability of a particular horse to being trained for your operation. The most popular for logging are the Belgian and Percheron. Other popular breeds, the Clydesdale and the Shire are less acceptable for logging because of the long hair or "feather" on their legs which become heavily encumbered with mud while working.

If you are not familiar with horses you should get help from someone to select your animal. Your draft horse should stand from 16 to 17 1/2 hands (a hand is 4") with a weight from 1750 to 2200 lbs. If you can locate the animal you want, that has been trained to log and is in good physical condition then it probably doesn't matter about the age of the horse; otherwise you should look for an animal between 3 and 10 years old.

The measuring up of a horse against your objectives requires a special experience and you should not select or buy a horse without this experience.

4.9.2 Care of the Horse

Care of your horse is all important. A horse cannot be put to work the day of purchase. It will require a lot of training and conditioning to get your

work horse to accept the discipline needed to understand and obey orders. A period from 1 to 2 months should be budgeted to carry out this training and to build the strength and stamina needed for full time heavy work. Again the use of a skilled horseman is necessary to instill the discipline and carry out the training. Usually your horse will train faster if put in the traces with another fully trained animal but this may not be possible.

Horse care does not end with training and conditioning. Feeding requires providing sufficient quantity of both hay and grain as well as a careful administration of salts and trace elements to ensure the animal gets the nutrient and fibre required. The quantity of feed will depend on the season, the work performed and the weight of the animal. As a rule of thumb you should provide the following daily:

- grain 1.1 lb per 100 lb of horse
- hay 1.25 lb per 100 lb of horse

If you allow the horse to pasture at night then you can reduce the hay supply to a token feeding during the work day.

Probably the most important area of care for your work horse is the hoof. If your horse works in good ground, without too much rock or broken gravel then you may not need horse shoes. This will save you money but not all that much time as you will still have to examine each hoof every day, cleaning gravel and thorns out of the frogs and rasping off broken pieces of hoof.

Shoes are necessary if you are using your horse on rocky or broken ground.

Other horse care items that you will become involved with will relate to digestion, wounds, skin problems, teeth, flies and other pests. There are many sources of good information for farmers or loggers with work horses and there are owner associations across Canada and the United States who will point you in the right direction. A very good reference is the Small Farmers' Journal, P.O. Box 2805, Eugene Oregon, USA, 97402. The B.C. horse logging association has members throughout the province.

4.9.3 Logging with Horses

Logging with a horse requires careful planning. You will know at the end of your horse's training what he will be capable of pulling and your operation will obviously be planned to suit this capability. Skid roads will be designed with favorable grades and with little side slope to ensure logs don't roll off the road.

If your timber is large you have a choice of bucking the logs shorter or using a team of horses. Unfortunately, a team requires a skid trail that is quite wide and this will be less attractive in selection or thinning operations.

- back strap and crupper
- tugs
- breeching
- rigging

Basic rigging will require a single tree and chains for log hookup and harness hookup. A good block, strap and two or three cables of different length as well as a peavey, tongs and a good swamping axe will also be necessary to assist in moving logs and preparing skid trails.

Logging by horse will use the same principles and concepts used in tractor skidder or cable methods. The difference lies in the speed and power of the equipment. The horse is slower and much less powerful than equipment powered by internal combustion. The success of horse logging depends on the skill of the teamster and the animal and intelligent use of simple machines.

Brute force will not work in horse logging.

4.10 Stand Tending

A major component of woodlot management will be the forestry activities related to the establishment and tending of the new crop of firewood. There are many references and useful tools to assist and guide in these activities. the following are the major stand tending activities.

REGENERATION

- to establish the correct species will be the initial concern. The guidelines set out in Appendix IV covering silvicultural considerations will be the main determinant for species selection. The Ministry of Forests has published these procedures in the form of Land Management Handbooks for each region of the province.

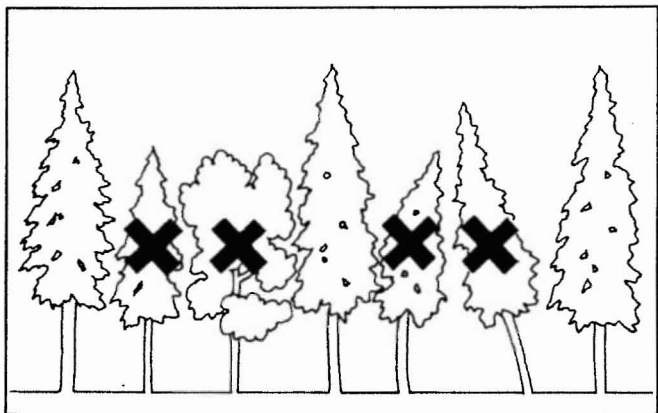
PROTECTION

- is the next phase in the tending of your new forest. This involves protecting the health and vigor of the new trees until they are well established and have grown beyond the threat of brush suffocation and browse damage. This process often involves brushing and weeding around your seedlings and replacing missing or dead seedlings.

SPACING

- may be necessary after the seedlings reach sapling stage. Normally this activity is carried out to improve the growth on the

remaining trees and the thinned stems are simply left on the ground to rot. If the thinned stems are larger, say 10cm. diameter and larger, then some firewood recovery may be practical. The cost of recovering the stems and turning them into firewood may represent a marginal or sub-marginal business but cleaning out the dead trees may enhance the residual stand appearance and the increase in financial return may be worthwhile if family employment is created.



Spacing – refers to the cutting of undesirable trees to allow future crop trees enough space to grow free of competition for water, nutrients and sunlight.

COMMERCIAL THINNING

- can be carried out, in even-aged stands, depending on species and soil productivity, sometime after the stand reaches 25 years. This stand tending process provides a “bonus” harvest while at the same time increasing the future harvest of the remaining stand. Volumes from thinnings do not form part of the allowable cut, unless provision for their volume has been deliberately added in.

5.1 Sale of Logs

Under this option you will at minimum define the areas and logs to be removed. In a thinning or selection application you will have to mark or define the trees to be cut and removed. In either process you must establish a means of monitoring the result.

If you choose to fall and harvest logs to roadside then you can sell them at roadside as logs, and the purchaser will pay you an agreed amount per truckload, per meter as scaled or on some other basis such as weight. Remember that you must have a registered timber mark for your timber regardless of whether your woodlot is privately owned, leased from others or is Crown land issued under a cutting agreement. Remember also that all forest products must be scaled and scale returns submitted to the Forest Service by a licensed scaler. (See chapter 10--Measurement).

The sale of firewood in log form will bring the least return to your woodlot and will involve the least labor input by you as owner. Your major involvement will be administrative and will definitely require some contract supervision and monitoring. You will of course lose ownership of your product at an early stage and if the buyer wants to reprocess or add value to the product he has the right and will gain any value added.

5.2 Sale in the Woods/Landings

You may find that all or portions of your firewood harvest can be handled directly in the woods. In this option you will have felled the trees you want and, if the major product is firewood, then you can invite buyers onto the site. If access is feasible, firewood can be cut in the woods and hauled out by the customer's vehicle. If travel is only available on your access roads then you will have to yard the logs to roadside or landings and pile the trees and logs for customers to buck and remove as cut firewood. This option does not provide a great deal of family employment on the woodlot but normally provides a reasonably good return to the owner without the owner having to buck, split, load and deliver to the customer.

This option does require a fair amount of supervision as most customers, given the choice, will concentrate on the larger pieces and leave tops and branches for someone else to cut. The protection of your resource from fire or other environmental damage is also important as, effectively, you have opened the doors of your woodlot to strangers. If you sell your firewood in this form you must monitor the outturn and

develop a system of charging for the product. Remember that some firewood products are more valuable than others and trucks are of different capacities. Your insurance agent will assist you in getting adequate protection for you in the event of an accident causing property damage or personal injury.

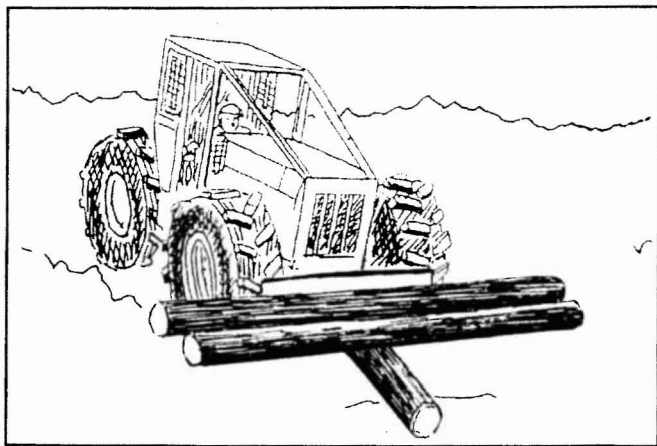
5.3 Firewood Processing by Hand

There are several distinct phases to firewood production. Each phase requires different skills and tools and is carried out at different times. No doubt you can fall, yard, buck, split, load and deliver your firewood one load at a time but your productivity will increase if you carry out each phase at an optimum level of production. If you are operating as a one or two person operation the limit of productivity will probably be between 3 and 5 cords for a workday. The range will vary widely as species, tree size, yarding distance and distance to market each have an influence on how much can be produced.

The highest productivity for bucking and splitting will probably be possible with alder, maple or aspen species but falling and yarding productivity will be highest in coniferous stands because trees are larger, more uniform and easier to limb.

Normally the most efficient operation will be one with a minimum of two people who work together carrying out falling and yarding to a central landing.

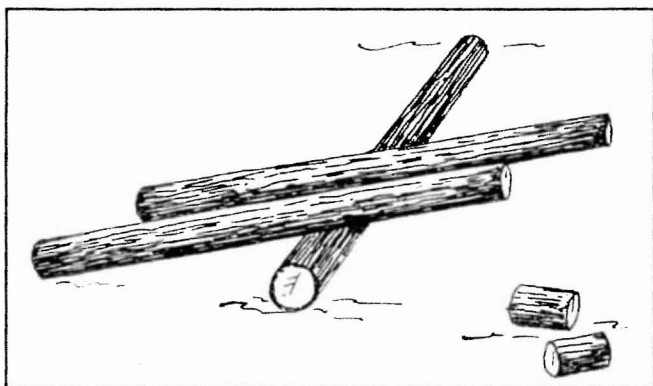
At the landing trees should be arranged for efficient bucking. This process can be made very efficient if a farm tractor or skidder with a powered blade is used to arrange the logs for bucking.



Use a bulldozer or skidder with a powered blade to arrange trees for efficient bucking at the landing.

By arranging the logs in parallel form on top of an old windfall or other large log the bucking process becomes very efficient.

- (i) Logs can be bucked by power saw with the worker standing up straight;
- (ii) The power saw can be operated without too much worry about the chain hitting into the ground;
- (iii) Logs are not under tension and underbucking is usually not necessary.



Example of a well organized workplace for bucking. By arranging the logs on an old windfall the bucking process becomes more efficient.

In practice this bucking technique works well. The logs initially are balanced on the cross log but, as bucking proceeds at one end, the balance shifts and bucking can change to the end resting on the ground while there is still some log weight available to relieve the tension on the remainder of the tree. A good long cross log and a large landing will permit an accumulation of up to 10 cords of bucked firewood. Splitting and removal can be carried out progressively while still yarding and bucking if the landing is large enough to hold two bucking stations.

The use of large landings or the use of several landings at the same time will permit the stockpiling of processed firewood for later delivery. The advantages of this procedure are many:

- permits air seasoning of processed firewood—seasoning is extremely slow in log form, and seasoned firewood is much lighter than green.
- permits the organization of processed wood for customized orders. You will know your inventory position for most effective marketing;
- permits more efficient use of labor by focusing efforts on one phase at a time;

5.4 Mechanical Processing

There is a wide range of options to save labor at the processing phases are many. The use of power saw, splitting axes and mauls, sledge hammer and wedge is the minimum equipment necessary to provide split firewood for home market. Additionally, even with a horse or some equipment to move logs in the landing, a peavey is very useful for moving or turning logs.

The use of a splitting machine alone is fairly popular where the blocks are large or rough and knotty. The splitters, however, require a fair amount of labor to feed and clear the blocks unless there are mechanical infeed and outfeed. When the splitter is designed with this amount of sophistication it is probably worth considering a processor that bucks, splits and stockpiles or loads firewood.

There are a number of technical reports and handbooks that have been prepared by FERIC (Forest Engineering Research Institute of Canada) evaluating firewood processors. References to these reports are available at the end of this handbook.

5.5 Productivity

Labor productivity in the firewood industry is extremely variable and largely determines the financial success of the venture. One thing is certain, the firewood business is hard physical work. Firewood is one of the most efficient heating systems known to man. It will keep you warm while you are falling it, bucking it, splitting it and carrying it as well as while you are burning it.

Regardless of the size of your firewood enterprise it will be important to always plan to have at least two people working together on all woods phases of the job. A system of safety checks and controls is required by regulation. Safe work practices and regulations are set out in detail in Chapter 6.

Worker productivity in the phases of falling, yarding and bucking is mainly affected by tree size and this can frequently be measured or estimated in advance by relating tree size to the number of trees required to produce a cord of firewood. Tree volume of course depends on tree diameter and tree height. The table in Appendix V shows some conversion factors that relate tree volume tables to tree volume plus bark because, normally, firewood when sold still contains bark. The estimated number of trees per cord usually becomes a matter of experience gained in each area of your woodlot. Some rough guidance for numbers of trees per cord is shown in the following tables.

IMMATURE FIR

DIAMETER D.B.H.		HEIGHT		AVE. # TREES PER CORD
CM	INCHES	METRE	FT	
20	8	16	50	12.0
30	12	19	60	4.5
40	16	23	70	2.0
50	20	26	80	1.2
60	24	29	90	0.8

ALDER

DIAMETER D.B.H.		HEIGHT		AVE. # TREES PER CORD
CM	INCHES	METRE	FT	
20	8	13	40	14.0
30	12	16	50	5.0
40	16	19	60	2.2
50	20	23	70	1.2
60	24	26	80	0.7

ASPEN

DIAMETER D.B.H.		HEIGHT		AVE. # TREES PER CORD
CM	INCHES	METRE	FT	
20	8	13	40	13.5
30	12	16	50	5.0
40	16	19	60	2.3
50	20	23	70	1.2
60	24	26	80	0.7

As mechanization is increased the importance of tree size to productivity decreases. Mechanical processors are normally rated in terms of cords per hour. The quoted ratings must be questioned carefully to ensure that lost time for worker or mechanical delays has been considered.

5.6 Custom Orders

The firewood business is characterized by being customer controlled. Orders often request specific volume, species, length, size of block (split or not), delivery date and state of seasoning. The matching of trees available to the customer order file is an important part of the business. It is important relative to productivity levels. This is also another very good reason to attempt to hold an inventory of ready-cut and stockpiled wood as well as documented procedure for maintaining an order file. A simple order file is shown in chapter 8 – Marketing.

5.7 Seasoning of Firewood

Normally, it is not wise to attempt to burn green wood. Moisture content of green or freshly cut wood varies significantly throughout the year and for different species and geographic locations.

The following table shows the heating value of different species of wood in millions of BTUs per cord.

OVEN-DRY WOOD HEATING VALUES

SPECIES	HEATING VALUE (MILLIONS OF BTU'S PER CORD)*
Douglas Fir	22
Coast Balsam	17
Interior Balsam	15
Hemlock	19
Lodgepole Pine	19
White Spruce	16
Ponderosa Pine	19
Red Alder	17
White Birch	23
Maple	21
Cottonwood	14
Aspen	18

* Based on the oven-dry weight (pounds per cubic foot) of 85 cubic feet of green wood.
BTU (British Thermal Unit)

Source: *Conversion Factors, Western Canada, Dobie & Wright Fuelwood, FRDA, Sask.*

Effectively the heating value is reduced with higher moisture content of the wood as it takes 1 BTU of energy to raise the temperature of 1 pound of water by 1° F.

Seasoning of wood in the woods is a slow process because the evaporation process from the wood is relative to the humidity of the surrounding air. Some average moisture contents as measured in laboratories are shown in the following table.

AVERAGE MOISTURE CONTENTS (OVEN-DRY BASIS)

SPECIES	MOISTURE CONTENT %		
	HEARTWOOD	SAPWOOD	MIXED
Douglas fir	39	151	45
Lodgepole pine	38	115	50
Red Alder	51	163	59
Birch	74	72	73
Aspen			90

Source: *Western Forest Products Laboratory & MacKay, J.F.G. 1974*

The moisture content can be related to wood density in the following tables.

WOOD DENSITY

SPECIES	WEIGHT OVENDRY (KG/M ³) (LB/FT ³)		WEIGHT GREEN (KG/M ³) (LB/FT ³)	
	Douglas fir	28.1	450	40.7
Lodgepole pine	25.5	408	38.3	613
Red Alder	23.1	370	46.4	743
Birch	31.8	510	55.1	882
Aspen	23.1	370	51.5	825

Source: *Smith, W.J. 1970 & Kennedy, E.I. 1965*

Ideally, wood will season best if split and loosely piled in the open where exposed to sun and wind. During the summertime, seasoning is relatively rapid and one month under ideal conditions will accomplish most of the seasoning.

5.8 Storage

Normally it will be impractical to store large volumes of wood in the woodlot for long term seasoning or marketing. Wood will start to deteriorate rapidly if left exposed to moisture and changing weather.

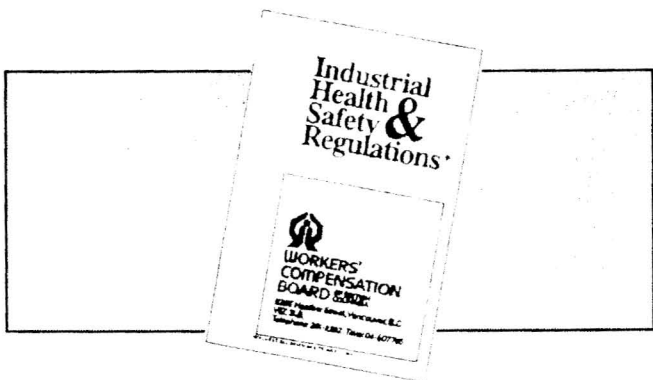
If seasoned carefully and delivered for use then wood can be stored for years if placed in areas where soil moisture will not be a problem. A roof over an area open to free air circulation will keep rain and snow from the wood and provide optimum conditions for firewood storage.

6.0 WORKING SAFELY

6.1 Safety in the Workplace-General

Worker safety in woodlot operations is extremely important. Governing regulations within British Columbia for industrial operations have been published by the Workers' Compensation Board. The regulations are enforced by the board and each employer must register with the Workers' Compensation Board. Additionally, First-Aid safety regulations apply to all industrial operations and, for woodlots or any forestry operations, a Class "A" hazard rating applies. These regulations stipulate that for operations with 1 to 5 workers you must have at least one worker qualified to administer first aid under the survival first aid program; with 6 - 10 workers there must be 2 qualified; with 11 or more the operation must have a qualified first-aid attendant.

The need to formally recognize the importance of safety on the job is covered by regulation. Even small operations are obliged to hold regular monthly meetings covering health and safety with the crew.



Industrial Health and Safety Regulations

If an accident does occur the employer must hold an investigation to determine what happened, what caused the accident and how to correct the situation. The Workers' Compensation Board has standard forms which must be completed and submitted for each injury or lost time accident.

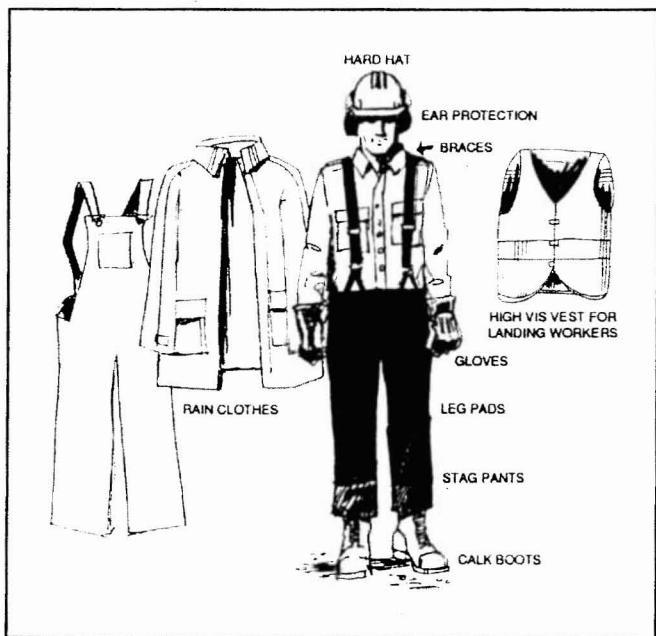
Before you establish your firewood business you should visit the nearest office of the Workers' Compensation Board. The head office is at 6951 Westminister Highway, Richmond, B.C., V7C 1C6 and their telephone number is (604) 276-3600. Staff at the head office will be able to direct you to the nearest district office.

6.2 Safety Equipment

Modern tools and machinery are usually designed with worker safety in mind but as a woodlot owner you must ensure that all equipment, tools and clothing meet at least minimum standards under W.C.B. regulations.

Personal protective clothing must also be worn by anyone working in the woods. Caulked boots are a must if walking on logs is part of the job and safety "steel" toes are important if crushing of the feet is a hazard. Other important clothing and gear must be worn if there is any danger of falling objects, saw cuts, debris flying or noise pollution. Specifically anyone cutting or moving firewood must be equipped with:

- gloves
- protective pads on the legs of work pants
- hard hat
- hearing protection
- eye protection
- communication device

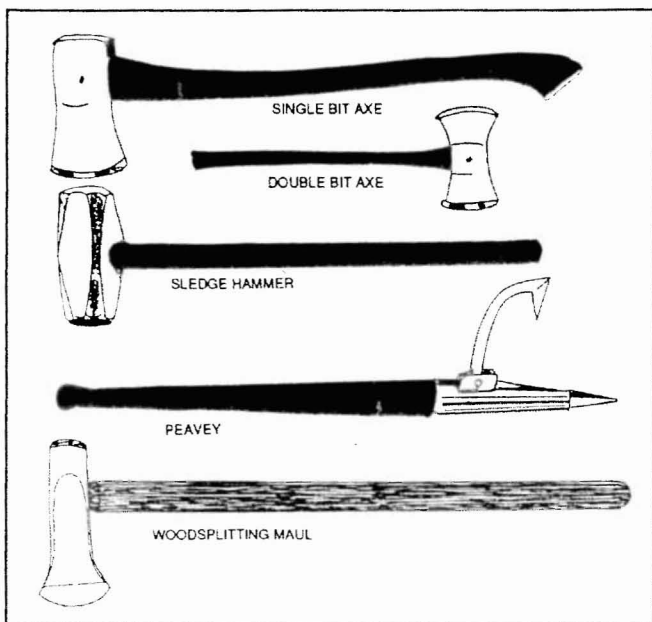


Clothing and personal protective equipment

6.3 Tools

Skill in the use of tools is an important safety aspect in the firewood business. The handheld power saw is the most important tool and the most dangerous of all tools. There is no substitute for experience in the safe use and care of the power saw but reference material on saws and saw use as well as the Handbook produced by W.C.B. for Fallers and Buckers should be read by all workers before using the saw.

In the splitting process the tools used are mauls, wedges, hammers and axes. Good handles are a must for safe use and they should be secure at the head with wedges and pins through the head. All heads and wedges should be kept sharp and free of burrs by filing or grinding.



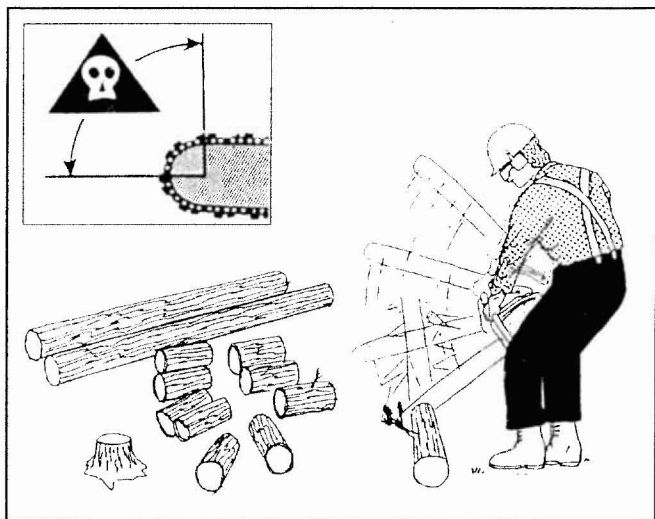
Commonly used hand tools for logging.

6.4 Safety-Process

The Workers Compensation Board recommends that "Job Safety Breakdowns" be prepared for each type of work or procedure. These documents are usually prepared by the people doing the work through a "think tank" process and form an excellent tool for ongoing safety meetings. The following paragraphs set out some of the ideas that would form the basis of Job Safety Breakdowns for firewood workers.

6.4.1 Falling & Limbing

This process is extremely hazardous and should not be attempted by the inexperienced. Falling by selection or in thinning operations is even more hazardous because of the difficulty imposed by the remaining trees. Equally as hazardous as falling is limbing. The heavy limbs of most deciduous species are often under stress and can easily result in saw kickback or unpredictable snapping. Directional falling of small trees in firewood operations can be deceptively dangerous as use of wedges is often not practical on small diameter trees.

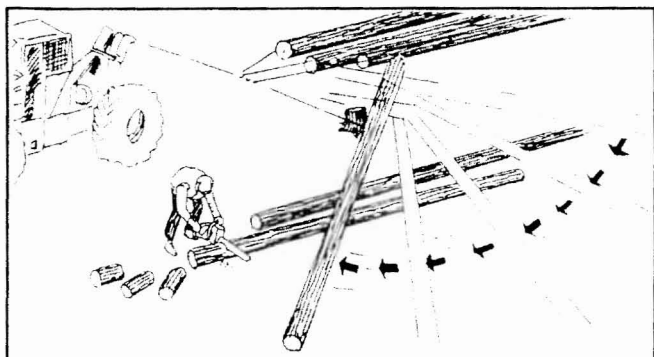


Be aware of the possibility of kickback hazards which can occur during the falling, limbing or bucking cut

6.4.2 Yarding

Whether by cable machine, rubber tired or cleated tractor or by horse this process is also hazardous. The main areas of concern are:

- Clearance
 - Stay out of the bight of cables.
 - Be prepared for tops or log ends whipping as the logs turn corners in yarding.
 - Watch for saplings, snags or debris being knocked down by incoming turns.
- Footing
 - Take care when walking or moving on ground or logs.
- Equipment
 - Stay clear of moving or swinging machinery.



Make safety a priority. Be aware of other activities as well as your own.

6.4.3 Bucking & Splitting

The bucking process for firewood will normally be in a landing. The major hazards to be aware of are:

- | | |
|--------------|------------------------------------------------------------------|
| Rolling logs | – Maintain good footing and stay alert with chosen escape route. |
| | – Do not permit log piles to become excessively high. |
| | – Watch incoming turns for whipping tops. |
| Log tension | – Be alert to potential snapping of logs under tension. |
| Equipment | – Keep tools in good working condition. |
| | – Watch for mobile equipment. |

6.4.4 Processing and Loading

While less hazardous than the other phases it is still necessary to stay alert while operating processing equipment or handloading trucks with firewood.

Equipment—Watch for moving saws, belts, chains and rollers. Ensure guards are all in place on machines and keep the work area tidy so that falling, tripping or slipping is not a danger.

7.0 PROTECTION OF THE FOREST AND ITS ENVIRONMENT

As a forest land owner and manager you are entrusted with a responsibility to protect the environment from being degraded by activities on the woodlot. It is well known that forestry activities have an impact on the environment and that when they are carried out thoughtlessly they can have a devastating effect which can take years for recovery.

The key to protecting the soils and other forest values on your woodlot is to know the characteristics of ground, terrain and drainage as well as the wildlife habitats. The inventory stage provides a good opportunity to identify these and document them on maps. Once you know where the sensitive sites are you can make plans to carry out your forestry and harvesting activities with minimum disruption.

7.1 Protection of the Soil

The soil is perhaps the most important resource that we have. Without it virtually nothing of value can grow, wildlife will move away and ground water storage can be severely diminished. Loss of soil can take a very long time for recovery.

Damage to soils on woodlots is most likely to occur through compaction or erosion by water. Compaction occurs when the soil is subjected to heavy weights—particularly when wet. Landings and skid trails are vulnerable areas because they are subject to heavy traffic. Some compaction is inevitable but it can be lessened by avoiding areas when they are wet, and by breaking up landings with a plough when they are no longer needed.

Erosion of the soil is a much more serious problem. Not only is there a permanent loss of soil, there is also a considerable danger that fine silt from the soil will be washed into streams and rivers where it can severely affect fish egg development. Fish eggs covered in silt will die from lack of oxygen. The biggest potential for soil erosion occurring on woodlots is from abnormal water movement. The faster the water moves the greater its ability to tear up and carry particles of soil. Steep slopes are therefore more vulnerable than gentle slopes to problems of erosion, although the nature of the soil itself is an important factor.

To avoid soil erosion by water movement it is important to try to preserve the integrity of natural water courses as much as possible. Roads provide the biggest problem because on a hillside they cut across the drainage courses and also act as new drainage courses themselves. Culverts should be placed under the road wherever there is an obvious drainage channel—even if it is dry. Where there are no obvious drainage channels, culverts should be placed at regular intervals in any case, because water will accumulate in the ditches during periods of rain or snow melt and must be released to the lower side of the road before it gathers too much volume or momentum.

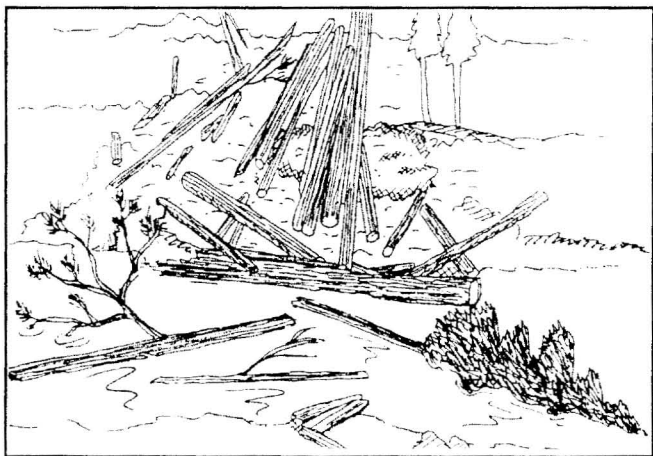
The same principles apply in harvesting with the use of skid trails. Care should be taken in planning skid trails to avoid concentration of water flows, and to avoid crossing streams unless provision has been made for a bridge or culvert. Gouging of the soil may not be very harmful in parts of the cutting area but when it occurs in or near a water course, the loosened soil may be washed away.

The wise woodlot owner will be constantly considering the potential effects of his activities on the soil and will take measures to protect this most valuable resource.

7.2 Protection of Water Quality

In the section on protection of the soil it was shown that eroding soils lead to siltation of streams and rivers. This is detrimental to fish habitat and can also affect water supplies for human consumption. So, protection of the soils goes a long way toward protection of water quality.

Even small streams are important. They often lead into larger streams or rivers which are important for the breeding of fish. Both the Federal and Provincial Governments are concerned about fish habitat and both have developed and enforce Acts and regulations governing the protection of fish streams.



It is both illegal and socially irresponsible to log across creeks

Care should be taken not to deposit debris in or near a stream. A certain amount of woody debris is present in all streams and rivers and this is beneficial. But sudden depositions of debris such as limbs and branches into a stream can cause a number of effects ranging from the

stream being partially dammed to alteration of the chemical balance in the water.

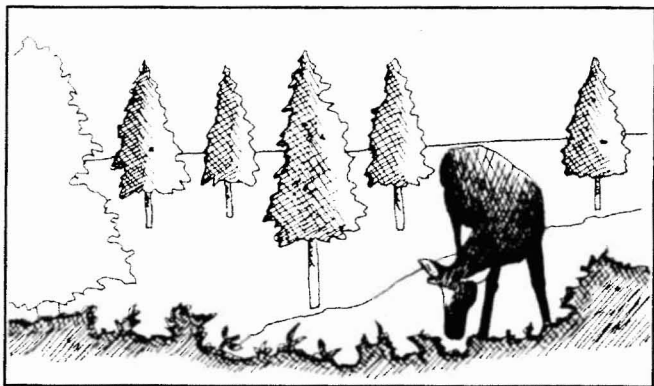
Water temperature is also a consideration in water quality. Trees overgrowing and shading a stream tend to keep water temperatures lower in summer and warmer in winter. This can be important for fish habitat, and in order to preserve this it may be necessary to leave some or all of this forest cover alongside the banks of the stream. In some cases the stream may benefit from being opened up to more sunlight and there is a danger of the residual trees left along a stream being blown over by wind. If the surrounding area has been clearcut, the streamside trees are susceptible to windthrow because their roots are often shallow and they are now exposed to wind forces from which they were previously protected by neighboring trees.

The best ways to protect water quality in streams are to protect the soil and leave the streams and rivers alone as much as possible.

7.3 Protection of Wildlife Habitat

Many wildlife species are sensitive to small changes in their habitat. Forestry activities, particularly harvesting, can make significant changes to the conditions which affect shelter, food supply and predators. These changes are not necessarily for the worse, in fact small clearcuts are known to provide an increase in forage while still providing the shelter and escape at the edges.

As with the other values that must be managed on the woodlot, it is important to be knowledgeable about the wildlife and its habitat. The Fish and Wildlife Branch of the Ministry of Environment can be very helpful in identifying critical habitats and advising on how best to preserve the wildlife populations.



Spaced and well-managed woodlots increase forage production for wildlife and reduce the incidence of disease.

7.4 Conservation and Aesthetics

Conservation implies the wise use of your woodlot such that the long term capability of the land to produce firewood and other benefits (eg. clean water, wildlife) is not compromised or degraded.

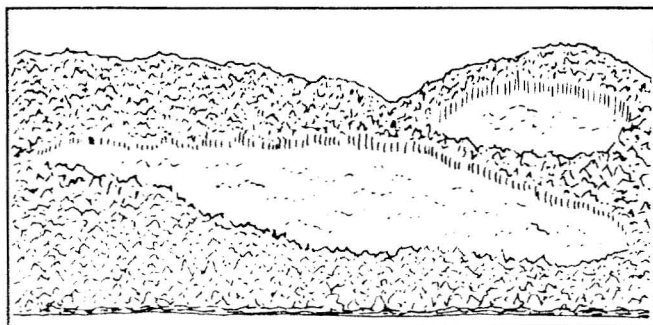
While firewood production may be concentrated on the use of one or two species, other native local species should be encouraged on sites not suited to firewood production. These sites might include steep slopes, ravines, wet areas, rocky outcrops and the edges of water courses, ponds or lakes. Other areas used for firewood production may require special harvesting or yarding equipment, or the timber may have to be harvested in stages or by the use of partial cuts to prevent conditions where erosion might be initiated.

Some patches of old growth or older second growth (particularly on sites such as described above that are not well suited to wood production) might be left to accommodate animal and plant life that may or may not be present in the production forest.

Snags and large woody debris on the ground in these areas are valuable habitat for small mammals, birds and insects and should be left wherever possible. Boundaries and fencelines can be maintained with native shrubs, brush and trees (subject to safety and access) which provide additional biological and habitat diversity.

Newly logged areas look messy but, even for clear-cut areas, slash burning is not recommended unless specifically needed to prepare a seed bed or eliminate the fire hazard. Slash should be "lopped and scattered". It decomposes surprisingly fast after seasonal changes subject it to rain and snow. Large piles at landings should be burned under appropriate conditions. Most areas are plantable even with considerable slash.

Some measures can be taken to reduce the visual impact of harvesting in your woodlot where scenic viewing or aesthetics are of concern.



This harvest follows the form and shape of the natural landscape and is therefore more comfortable to the eye than square or rectangular cut blocks.

Selection cutting where feasible would be a first consideration. Secondly, where clear-cutting is appropriate, use small openings with irregular shapes that blend into the contours of the land. Straight lines emphasize the cut area, irregular lines following breaks in the terrain appear more natural and less of a focal point for the eye. Scatter any piles or clumps of slash and avoid any linear accumulations along boundaries by either scattering or, where feasible, varying the felling direction from time to time. Lastly, re-establish a new forest soon as possible. The planting of small areas can frequently proceed the same year as harvesting takes place provided season and weather are appropriate.

Man-made debris or garbage can quickly destroy the pleasing aesthetics of a woodlot. As appropriate, burn, bury or remove junk and garbage. Cans or drums containing any oil or chemicals should be removed as they are not only unsightly but hazardous to the site. Areas where oil was spilled (i.e., around landings) may need special attention.

Where possible small concentrated spills can be "dug-out" and the earth scattered widely. In other cases the surface should be broken up or "scuffed". In some situations scattering fertilizer over the scuffed area will promote rehabilitation in the form of quicker vegetation establishment.

7.5 Fire Protection

Fire remains the most severe hazard to the forest. It can start so easily and, given the right conditions, can destroy large areas of valuable timber and wildlife habitat in minutes. A healthy respect for fire is essential in forest management and an understanding of fire hazard, fire behavior and precautions that can be taken will help reduce the risk of major losses on your woodlot.

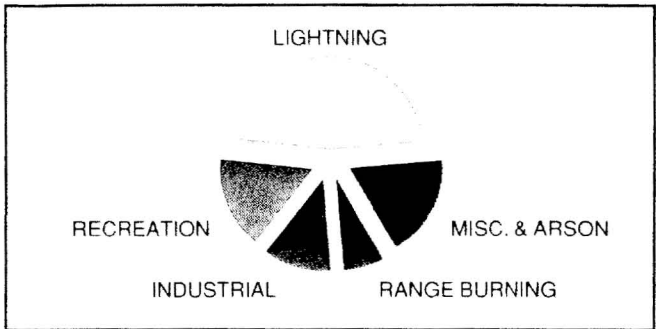
The Forest Service has always treated fire prevention as one of its most important duties and it pursues this through the Forest Fire Prevention Regulations—a comprehensive set of rules and obligations applicable to everyone's behavior in or near a forest during the fire season (April 15 to October 15). The regulations provide minimum standards for fire preparedness including fire tools to be kept at the worksites, disposal of hazardous accumulations of slash, and when to stop working if weather conditions make operations risky.

You must obtain a copy of the Forest Fire Prevention Regulations. They are available from district offices of the Forest Service. Read them carefully and ask advice from the district office if you are unsure of their meaning in your circumstances.

7.5.1 Causes of Fire

Lightning strikes are the greatest cause of forest fires in British Columbia. Almost half of all fires over the past ten years are attributable to this cause. There is, of course, little or nothing we can do to prevent

lightning and efforts must be concentrated in early detection and rapidly extinguishing these naturally caused fires.



The other main causes of forest fires are:

- Industrial activities in the forest
- Cigarettes
- Uncontrolled campfires

Unlike lightning, these causes are largely controllable through good planning, care and discipline.

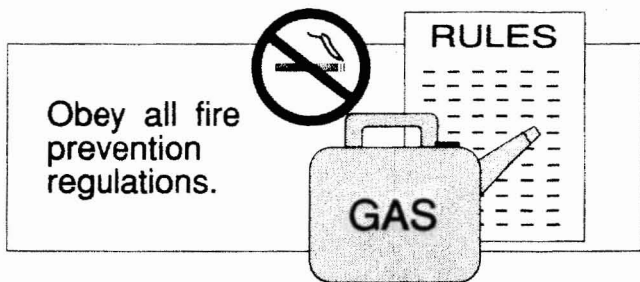
Several risks are presented by industrial activities. Cable logging systems should be noted because there is danger of moving cables rubbing against dry wood and starting a fire by friction. Sparks from welding or metal grinding activities are also common causes of fire.

Carelessly discarded cigarettes could be a cause of fire on woodlots if people are allowed to smoke while working on forestry activities or if there is a public access road beside or through the property. There are still people around who will flick their cigarette out of the window of their car.

A campfire that is built too large or one that is abandoned before it is fully extinguished can also be a hazard. If strong winds start, there is a danger of sparks being blown into nearby timber and starting a blaze.

7.5.2 Reducing the Risks of Fire

In the previous section we listed the main causes of forest fires and while we can take precautions to prevent them we must also be prepared to control them quickly before they cause major damage. The most important considerations are to keep a healthy respect for fire and to be prepared for it happening. This section provides some hints about the most effective ways of avoiding or preparing for forest fires.



- Obtain a copy of the Forest Fire Prevention Regulations and be sure to understand them and to comply with their requirements, remembering that they are only minimum standards.
- Try to get experience with fire behavior. The Forest Service sponsors short courses which use a fire simulator. These are well worth attending and details can be obtained from the district offices.
- Keep your fire fighting equipment near to the activities and in good working order and make sure that there are sufficient lengths of hose, spare parts etc. to deal with the unexpected.
- When operating in a part of your woodlot, run through the actions you and your crew would take to deal with a fire.
- Try to find a good observation point where you can get a good overview of your woodlot and use this point after a lightning storm has passed through—remember that spotting small fires can be difficult and requires patient systematic observation.
- Be aware of the kind of activities which can most easily cause logging fires—e.g., running cables, sparks from powersaws, welders or metal cutting.
- The Regulations classify the various activities carried out in the forest into hazard categories. The greater the hazard the greater must be the degree of preparedness. Be sure to know the hazard ratings for each activity you pursue and make sure you can meet the minimum standards of fire fighting equipment, etc.
- Be aware of weather conditions and how these can dramatically affect the risk of fire occurring and spreading. Make sure you know what the forest fire weather hazard rating is on any given day. This information is available from the local district office of the Forest Service and is usually posted at various points beside highways as Low, Moderate, High or Extreme.
- Never hesitate to seek advice from the Forest Service and be sure to alert them immediately if a fire does break out.

THE CANADIAN FOREST FIRE DANGER RATING SYSTEM

DANGER CLASS

I	Very Low
II	Low
III	Moderate
IV	High
V	Extreme

The Forest Fire Danger Rating System incorporates information from fire reports and actual field studies. Contact the Forest Service office in your area for more information.

7.6 Protection from Forest Pests and Disease

Insect and animal pests and tree diseases caused by fungi, bacteria, viruses and parasitic plants are responsible for large losses in timber volume each year. Most of the time these pests and diseases exist in harmony with the forest but from time to time the conditions are right for a disease or pest population to multiply to a level where an epidemic outbreak can severely threaten the health and life of large areas of forests.

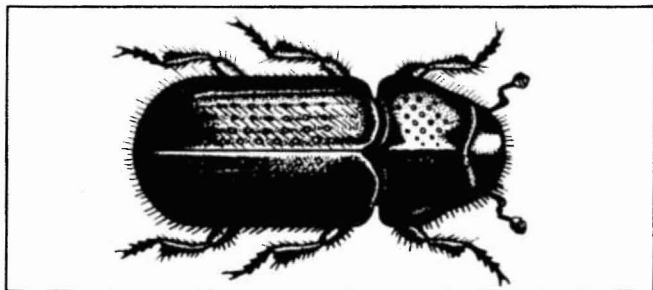
Recognizing the presence of pests and disease is not easy. There are signs which indicate that the trees are unhealthy—such as excessive browning of the leaves or resin discharges from the stem, but identification of the disease or pest may need the services of an expert. This advice can be obtained freely from Forestry Canada through the Pacific Forestry Centre, 506 West Burnside Road, Victoria, B.C. V8Z 1M5.

Forestry Canada experts regularly conduct forest insect and disease surveys throughout the province, tracking the progress of diseases and pests and providing local advice where needed. A report is published each year showing the results of the survey and predictions of pest and disease movements for the near future.

7.6.1 Forest Insect Pests

Insects cause greater economic loss than any other pest group affecting British Columbia's managed forests. When conditions are right the population of an insect pest can increase remarkably quickly with a corresponding increase in the level of damage to trees. While the

conditions for the high population continue to exist the epidemic can continue, but eventually there will be a change and the high population will collapse just as dramatically as it was formed.



If left unchecked, beetle infestation can devastate valuable timber stocks.

The types of insect pests important to forestry may be categorized into either of the following three:

- (a) Defoliators—feed on foliage and buds by cutting and chewing. They are the most common and are responsible for most of the damage by insects.
- (b) Sucking insects—pierce and remove the sap from needles, branches or stems.
- (c) Woody tissue feeders—feed on the outer sapwood of the main stem, branches, root collar and roots.

Most of the damage is done by the insect while in its larval or caterpillar stage. This takes place only for a short duration in the year. Often, evidence of their presence only shows after the insects have left, and this might show up as deformity or yellowing of the leaves, pitch or resin deposits on the stem or tunnels in the wood, and sawdust deposits on the tree.

If the damage is quite extensive, contact the Pacific Forestry Centre and explain the damage and the tree species being affected. If possible collect a specimen of the insect or parts of the tree showing damage. Experts will willingly identify the insect and advise you what you can do to try to prevent the spread.

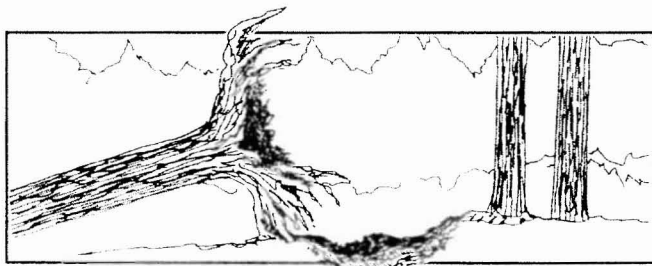
7.6.2 Forest Diseases

Forest diseases are second in importance to insect pests for timber losses in B.C. Their activity is much less dramatic as they work quite slowly and are therefore not very obvious but, unlike insects, the disease is present continuously.

Fungi of various kinds are the biggest disease threat to the trees.

They eat away at the tissues of the tree from the foliage to the roots. These various fungi can be divided into groups according to the effect on the tree. Some of them are:

- stem and branch cankers which cause weakness and swelling in the stem or branches of the tree.
- branch and stem rusts which can kill the host tree by eventual girdling of the tree by the canker that is formed.
- needle casts and blights which attack and can kill or cause premature dropping of leaves from the tree.
- root diseases which destroy tissues in the root system. The roots are less able to provide the nutrients needed by the tree, causing it to grow at a much slower rate. Eventually the root system is so weakened that the tree may fall over.
- destructive parasites known as dwarf mistletoe threaten lodgepole pine, Douglas-fir, western hemlock and western larch. Mistletoes feed on their host's tissues causing swellings and deformities, slowing of growth and the characteristic witch's brooms. Infected stands will suffer a high incidence of death in the trees.



Root diseases destroy tissues in the root system.

Many of these diseases can be difficult to detect. If you suspect that you have a tree disease problem, experts from Forestry Canada can help with identification and advise as to what to do. All fungi produce a fruiting body of some kind often in a mushroom shape. Collect samples of these fruiting bodies if you can and describe the effect on the tree so that experts can better identify the problem.

Your forest management practices can help to reduce the risk or effects of disease. Choice of species when re-planting can be important, especially where root diseases are present. The disease can linger in the soil for many years and will infect young trees if they are susceptible. When you are replanting an area known to be infected seek advice as to the choice of species.

Mistletoe control is best done by removing all infected trees at the time of harvest.

Unfortunately there are few effective options for control of diseases in timber stands. Perhaps the best is removal of infected trees and replacement with less susceptible species, but this is often not practical.

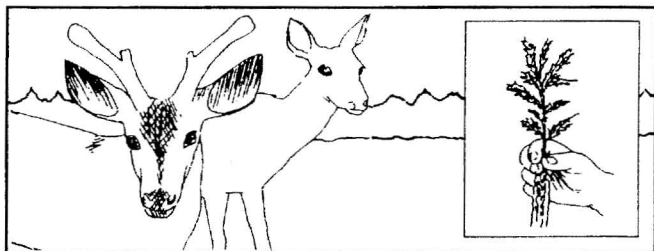
For further information about pests and diseases it is recommended that you obtain a copy of the "Field Guide to Pests of Managed Forests in British Columbia" – Joint Report No.16. It is available from Forestry Canada, Pacific Forestry Center and contains descriptions and good color illustrations of all the most common pests and diseases affecting forest management.

7.7 Browsing

It is satisfying to have wildlife share the forest. They are as much a part of the natural scene as the trees we are growing and managing. Protection of their habitat is discussed earlier in this chapter but what do we do when the animals themselves threaten the health of the forests? The greatest cause for concern arises from the browsing of young trees by deer. They bite off and eat the young succulent shoots as their preferred diet leaving a wounded seedling. This will stunt the growth of the tree and make it very bushy at a time when we need it to grow quickly and win the competition for light and soil nutrients against other vegetation nearby.

There are a number of things that can be done to discourage or prevent browsing. First, keep the deer population at a reasonable level. If there are too many, they will be looking for new sources of food and will cause considerable problems. To maintain a steady population some may have to be culled or transferred to another location. Second, you may have to place wire cages over the seedlings to protect them. These prevent the deer from being able to reach the shoots and are reasonably effective. Some work has been done with chemical deterrents which, when sprayed on the seedling, discourage the deer from eating the shoots.

The Fish and Wildlife Branch of the Ministry of Environment and the Forest Service Silviculture Branch will be able to help you further.



A balance must be struck between sharing woodlots with wildlife and preventing deer from browsing juvenile trees and seedlings.

8.0 FIREWOOD MARKETING

8.1 Products

The concept of managing your woodlot for firewood as a main product is not unique for British Columbia. Traditionally forest operators have sought diversity of product with the objective of producing the most valuable products from each tree and thus achieving in total the most value per hectare.

Firewood, as a major product, can produce a relatively high value per hectare if the product is processed and marketed to its highest form for the consumer. The long range return on a per hectare per year basis has even more value because the rotation period for firewood will be shorter than for sawlogs, poles and other valuable products.

In terms of relative value per unit of volume at the consumer level firewood can be listed in descending order of value as follows:

PACKAGED

- Kiln dried fuel and/or kindling for cottage or holiday use. Normally sold in small bundles in shopping centres.

CUSTOM CUT/SPLIT/SEASONED

- Specific in species, length, size of block, volume of order (as little as 1 face cord). Normally delivered to the customer's residence.

CUSTOM CUT

- Not split or seasoned, random or mixed species, cut to the customer's specified length.

FUEL CHIPS

- Chips produced for industrial users such as schools, hospitals, and greenhouses. Chips must meet size and moisture specifications and are normally delivered to customer's storage.

TRUCKLOAD

- Log truck load delivered and unloaded at customer's residence.

"U" CUT

- Customer cuts your wood for himself on your property. Normally pays per truck load.

STUMPAGE

- Customer or contractor pays you for firewood standing as trees on your woodlot or he may buy logs or trees left behind from your other harvesting operations.

8.2 Cost of Firewood Relative to Other Fuels

The use of firewood in an open fireplace in the home as a focus for social gatherings and for room comfort and appearance rarely will be considered as economical in comparison with other forms of heat. For

heating the home, however, firewood can compete economically with conventional heating sources when an efficient stove is used.

The following table of relative heat values sets out the basis for comparison.

RELATIVE HEAT VALUES OF VARIOUS FUELS				
Fuel	Unit of Sale	Btus/Unit	Combustion Efficiency	Effective Btus/Unit
Alder (20% moisture content)	Cord	17,500,000	65%	11,400,000
Oil (home heating)	Gallon	166,500	75%	124,880
Electricity	KWh	3,400	100%	3,400
Gas	Billing unit	94,800	80%	75,840

Source: *Energy, Mines and Resources, Canada, 1980 - The Feasibility of a Home Heating Fuelwood Industry on Southern Vancouver Island - Enfor 1981*

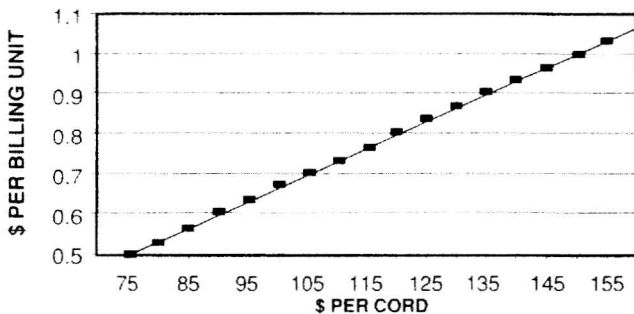
Current costs for different energy forms can be plotted on charts to show whether firewood is cheaper or more expensive than the alternative.

As an example, the mid 1990 selling price for seasoned alder firewood is shown on the following charts with 1990 price for oil, electricity, and natural gas in Victoria, BC. You can determine the situation in your community by using local prices for each form of energy.

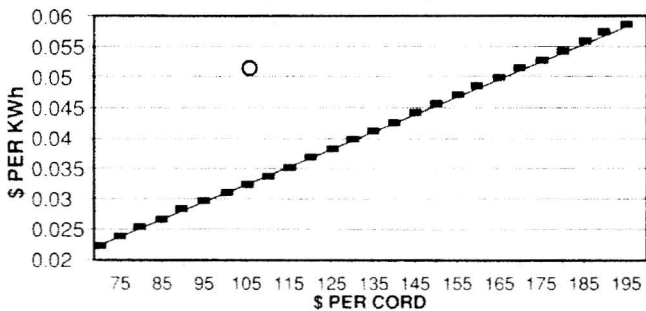
Note: Points 1-4 refer to the graphs (burning efficiency of various fuels) on page 60.

1. The burning efficiency assumed for fuelwood (65%) implies a modern air-controlled stove. The wood is assumed to be red alder at 20% m.c., or equivalent.
2. The diagonal line on each graph shows the unit-price at which fuelwood provides equal-cost heating to the named fuel.
3. Installation or conversion costs for burning systems are not included.
4. The circles show prices for electricity and home fuel-oil in the Greater Victoria Area in Spring 1990. Note that the equivalent price for fuelwood would be about \$165/cord versus electricity and about \$135 versus oil. The delivered price for fuelwood at the time was about \$105.00 per cord.

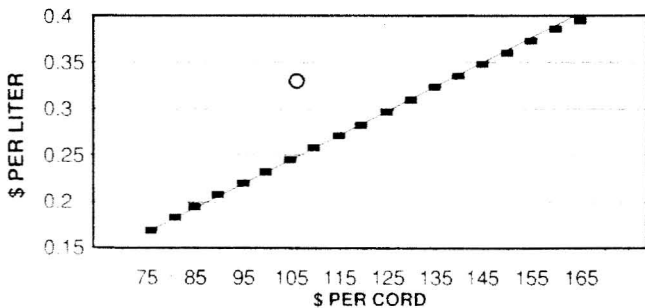
NATURAL GAS vs FUELWOOD
Equivalent heating costs



ELECTRICITY vs FUELWOOD
Equivalent heating costs



HOME FUEL OIL vs FUELWOOD
Equivalent heating costs



8.3 Market Identification

Before you decide to focus on firewood as a business for your woodlot you must know the potential volume and types of product that are used in your market area.

The market for custom cut home firewood is usually identified very clearly in the classified section of your local newspaper. Independent firewood cutters usually advertize their product and the unit price on a weekly or daily basis. This can be used as a guide to the price range for the different species, sizes and degree of seasoning for custom firewood.

To determine the market potential in your area you must carry out a market survey. A market survey can be reasonably complex or relatively simple and the intensity of your survey should relate to the importance of the financial decisions you will be making. The objectives of the market survey will be to determine:

DEMAND RELATED INFORMATION

- Volume of firewood used annually
- Type of firewood used
- Number of households and their geographic location
- Industrial firewood market
- Commercial Market—Hotels, campground, restaurant

SUPPLY RELATED INFORMATION

- The sources of firewood supply:
- Quantities currently supplied: by types; by source
- Current price by type of firewood
- Competing suppliers

Market survey information on demand can be acquired in a variety of ways. Good sources of information are:

- Telephone surveys
- Real Estate catalogs
- Local Chambers of Commerce
- City Industrial Development Staff
- Provincial and Regional Development Staff

Market survey information relating to supply can be acquired from:

- Ministry of Forests district offices
- Local Industrial operators
- Sawmills and other converting plants
- Chambers of Commerce
- Local newspaper for names of dealers and their price

8.4 Advertizing & Sales Promotion

In order to get established in the home firewood business there will need to be some advertizing for market exposure.

ADVERTISE IN THE LOCAL PAPER

- An "ad" should be placed in the local newspaper (daily or weekly) that will reach the people or market you are interested in. The ad should be timely and concise but informative. The best times are early spring to start people thinking and late summer to attract the bulk of the market.

If the ad is very short or basic it can be re-used or re-inserted as the need arises.

For this type of ad, particularly if price is not quoted, it is important that you have a good phone answering capability so that inquiries as to price and other particulars can be provided immediately.

Longer ads with more detail may be suitable in some situations. These ads usually try to give sufficient information so that a purchaser can decide to buy and is in effect actually placing an order.

<p>For Sale FIREWOOD</p> <p>Seasoned Fir or Alder U-Haul or Del. 672-0000</p>	<p>For Sale FIREWOOD</p> <p>Seasoned - Split, Del. Your town: Fir \$120/cord, Alder \$105. Also green, unsplit, U-haul. 672-0000 Joe Smith, Lofthouse Rd.</p>
--------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Sample ads

BUSINESS CARDS

- Business cards should be available for distribution by you and your family or employees. These cards should not give details that might change (i.e. price) but should show your full name and mail address as well as location and your phone number. The product should be described in broad terms (for example: "custom firewood sales" or "firewood: wholesale and retail").

Business cards are relatively inexpensive but only reach one person at a time. For this reason they should be widely distributed. Sometimes local hardware stores or stove shops will assist in distribution. In some areas "bulletin boards" are available. Business cards are also a reminder for where to come, and for some known customers, where to send payments on account.

CONTACT LOCAL STORES/SUPPLIERS

- You should make a point of visiting stove stores or hardware stores that sell stoves, pipes and accessories. They will likely promote your product if you promote theirs.

LOCAL FAIRS & COMMUNITY EVENTS

- Depending on your location and circumstances attending local events or fairs and promoting your product can be worthwhile. By all means invite customers or local groups to see or tour your woodlot if this is safe and feasible.

REPEAT CUSTOMERS

- Try to build on repeat customers. Where possible, phone or send an order form to these people before the cold season.

Once a business is established the key to ongoing sales and expansion will be performance. The key items that make for satisfied customers are:

- Reliable delivery
- Competitive prices
- Product satisfaction related to order
- No shortfall on quantity

Satisfied customers will pass the word to their neighbors and friends and you may end up with more demand than your woodlot will supply. In this event you can focus on customers closest to your woodlot that can use your most plentiful product. Unfortunately the firewood business has a reputation for unreliability, usually because a number of operators enter the business with good intentions but very little supply. A woodlot owner, who is growing his own firewood, will quickly establish his credibility so long as the other areas of concern are dealt with.

8.5 Building an Order File

You will have to develop a systematic approach to gathering and recording orders. A check list beside the phone is the best control to ensure telephoned orders are fully documented, and a customer file will help to provide good service to your repeat clients.

Note the date, name of the purchaser, their home address and the address where you are to deliver the order, details about the order (preferred species, preferred length, splitting instructions...etc., schedule requested), the price quoted, payment method, and any special instructions.

CUSTOMER FILE

NAME:				
Date	Telephone:			
Address				
Address to deliver to:				
ORDER				
Preferred Species	Seasoned	<input type="checkbox"/>	Green	<input type="checkbox"/>
Quantity	Preferred length (range)			
Splitting instructions:	Price Quoted:			
Schedule requested				
Payment Method:	Quoted	<input type="checkbox"/>	Not Quoted	<input type="checkbox"/>
Special Instructions:				

Sample customer file.

Your order file will increase and decrease throughout the year. Recognize that most people will think of their firewood needs as the end of summer approaches and will want their firewood delivered as soon as possible after they order. Some people will order early and plan to get their wood stacked and seasoned through the summer but these customers represent a minority. Advertising in local papers early in the spring may assist in getting the order file started.

Realistically you must limit your order file to your capabilities. If, for example, you will produce 500 cords per year from your woodlot and during the peak of the season can deliver 4 cords per day then you should not let your order file exceed about 80 cords. This represents about 1 month of deliveries and probably represents the longest period most customers are willing to wait for delivery.

8.6 Maintaining an Order File

Your telephoned orders must be added daily to your order file with the full detail gathered on your check list. At the same time each day's deliveries must be checked off and the order updated. You can keep your order file in a looseleaf or exercise book or on a home computer. The exact format will be adjusted to suit the business you have. An example of the order file headings follows:

ORDER FILE

ORDER DATE	NAME	DELIVER TO:	VOLUME	SPECIFICATIONS	LENGTH	OTHER

DELIVERY DATE	PRICE QUOTED	VOLUME CHANGE	DELIVERY CHANGE	REMAINING ORDER

Sample Order file.

At any time it is relatively easy to determine the total volume and variety of orders outstanding and priorities for work and delivery can be assigned. Appendix VI provides a blank order file which can be photocopied and used for your orders.

8.7 Customer Relations

Remember that your customer looks at his annual firewood purchase as an important investment. Neighbors and friends are often chatting about their firewood supply, where it came from, the price, quality and any problems associated with delivery. If you are reliable you will get new and repeat business; if not then someone else will get your business.

After you have taken the order you must keep your customer informed. If you must delay delivery, let them know. In any event you must phone before delivery to ensure the customer is ready for you and has a spot to dump the load and will be there to make payment. Cash on delivery is the norm for the firewood business and if the order will take several days to deliver then you should arrange for payment after completion of delivery.

For your own records a simple receipt for payment should be delivered to the customer with a copy for your records.

If you have treated your customers well, then customer complaints will be rare. If, however, you do receive a complaint then deal with it promptly and fairly. Complaints will occasionally be raised over the volume delivered. You will find that some customers are very adept at piling firewood with very little air space. If you receive a valid complaint relating to volume you should visit the customer and make adjustment either in price or by delivering more wood.

9.0 BUSINESS MANAGEMENT

9.1 The Business Plan

Chapter 3 reviewed the degree of planning needed for your firewood operation. The forest management plan deals with long range forecasts, yields, area and activities. The annual plan or budget deals with specific month by month activities with costs and revenues. This annual plan is really your business plan and, to be successful in the firewood business, it should be carefully developed.



Carefully develop your Business Plan

The following elements must be considered when developing your annual plan.

ACTIVITIES

- where will you be working in your woodlot: blocks and areas
- what activities are required:
 - (a) road and landing construction (see Sec 4.4)
 - (b) harvesting (see Sec 4.5)
 - (c) firewood processing (see Chapter 5.0)
 - (d) firewood marketing and delivery (see Chapter 8.0)
 - (e) forestry, silviculture, site preparation (see Sec 4.3)

Each itemized in terms of volumes, areas, length of road, or numbers of seedlings.

EQUIPMENT AND OPERATING NEEDS AND COSTS

- capital purchases
- major repairs planned
- operating and ongoing repair costs
- rental or contract equipment
- operating supplies and equipment

LABOR

- number of person-days for each activity
- cost of each person-day including employment expense
- contract labor costs

OVERHEAD

- cost of running your office
- cost for insurance
- cost for accountant, legal and other outside costs
- interest expense

REVENUES

Revenues by source

- firewood
- other forest revenues
- interest and investment income

Your budget will evolve if you carefully consider each of the preceding elements and use the costs and revenues from each of them as building blocks. The budget will be put together one month at a time for the year, and, at the end, must be carefully examined to see that it is acceptable and realistic.

If the costs exceed the revenues anticipated then some way to cut costs or increase revenue must be considered. If you require more person-days than your family or organization can supply then ways and means of reducing labor required, or augmenting the supply, must be considered.

The final budget will show a summary by month, all the elements, their units of measurement as well as costs and revenues. A sample annual budget for the Daisy Creek Woodlot is shown in Appendix III.

9.2 Working Capital

Your annual budget will show in detail the expectations and needs for the forthcoming year. This plan will form the basis for working capital needs. Examination of the sample annual budget for Daisy Creek Woodlot shows that costs for the first four months exceed revenues. Obviously it will be necessary to find some means of carrying on the business until cash flow is sufficient to cover the shortfall. The cash shortfall at any point in time must be covered by working capital which can be supplied from a number of sources. In a family venture working capital is often supplied by the family who forego wages earned until the cash is available. This form of capital is called a shareholder or owner loan and is a good source of working capital unless the family needs the money for other purposes.

The bank or other lending institution will loan money for working capital but only if the business plan is well prepared and shows a good return over the year. The bank will insist on some form of security, or loan guarantee or both. Interest charged on working capital will fluctuate relative to bank prime rate and usually will be 2 to 2 ½% above prime.



The lending institution will draw money for working capital only if the business plan is well prepared and shows a return over the year.

A sample cash flow forecast for Daisy Creek Woodlot follows the annual budget in Appendix III. An assumption is made that a working capital of \$10,000 is available at the start of the year.

9.3 Cost Management

As well as showing your cash flow and cash requirements, the annual budget provides the base for a number of management control functions. You can measure results at the end of each month (or even at intervals through the month) to determine whether your progress is on track.

Every activity can be measured as well as expenditures and revenues. If any area is out of line with the budget then some form of correction is needed. The types of activity that will be important to measure for control are:

- (i) Labor employed compared to production—productivity.
- (ii) Equipment hours used compared to production—productivity.
- (iii) Equipment hours not available because of breakdowns or repair time.
- (iv) Revenue (Collections) related to earnings—accounts receivable.

In order to carry out the cost management functions you must have some form of record keeping. The form of record keeping you maintain will vary and may consist of a package purchased from a bookkeeping or accounting firm or be derived from records that you design and maintain yourself. Whatever the degree of sophistication of your record system it will be your "Accounting System" and must have certain minimum requirements.

PAYROLL

- You must maintain payroll records sufficient to satisfy Federal requirements for employment records and submission of payments for Canada Pension Plan (CPP), Unemployment

Insurance Contributions (U.I.C), Income tax withheld and employment benefits. The records must also be adequate to satisfy the employee and to permit you to measure performance against a particular job or activity.

CASH TRANSACTIONS

- You should have a bank account reserved for your firewood business. In this form every cash transaction each month can be charged or credited to an assigned project or code. In accounting terms the distribution of these transactions by code is known as a "synoptic" or "cash book".

Non-cash transactions such as depreciation on capital equipment (capital cost allowances) or adjustments to codes already posted do not have to be done monthly but must be done at least annually to permit the submission of income tax returns for the business.

9.4 Goods and Services Tax



Contact your local Revenue Canada Excise office for information on the G.S.T.

This Federal tax on all goods and services requires that a tax be applied on all sales and submitted to the Federal Government. A rebate, equivalent to the tax paid by you, for all goods and services you use to produce your firewood or other products sold can be claimed and withheld in your returns to the Federal Government. There are several optimal procedures approved by Revenue Canada for handling payments and rebates. You should investigate the options, but make sure your business is registered if its income is expected to exceed the minimum amount for qualification (\$30,000 per year in 1991).

9.5 Owner Responsibilities

Over and above the accounting, taxation and payroll responsibility you have many other obligations as an owner and employer, even if you are only employing your own family.

Some of these obligations are:

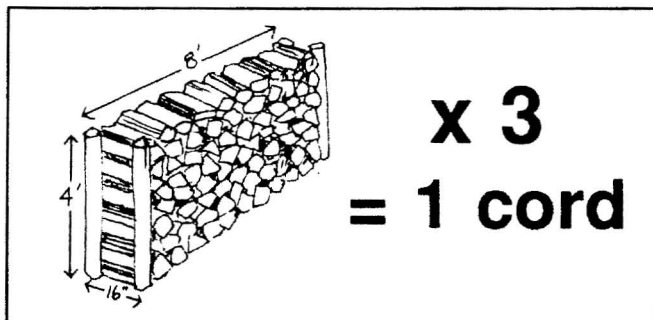
- (a) You must follow the employment standards regulated by the province of B.C.
- (b) You must register as an employer under the Workers' Compensation Act of B.C.
- (c) You may be required to purchase a business license to permit sales of firewood within nearby cities or municipalities.
- (d) If you operate your woodlot as a managed forest under the Assessment Act of B.C. then you must have an approved forest management plan to qualify. Regular annual reports must be submitted on harvesting and other performance relative to the plan.
- (e) As an owner of forest land you must ensure that any wood cut and sold is scaled and reported to the Ministry of Forests. The scaling procedures for firewood are set out in detail in Chapter 10. Normally you will be able to become accepted by the Ministry of Forests as a "licensed" or "official" scaler under the Forest Act. You must also have applied for a timber mark for your property from the Ministry of Forests.
- (f) Resource agencies are not normally involved in monitoring or approving activities on private land. The Federal Fisheries and Oceans ministry does insist on reviewing plans and activities that involve fish streams used by salmon and of course the owner is responsible to ensure that all regulations under the Federal Fisheries Act are met. You must adhere to provincial forest regulations pertinent to fire protection, fire suppression and slash disposal.
- (g) If part of your woodlot is Crown Land, licenced to you under the B.C. Forest Service's Woodlot Program there are several planning and reporting requirements which must be adhered to. These are, or will be, specified in the licence document, and the local district office will provide you with all the information you need to work within their regulations.
- (h) If your woodlot is within a municipality or improvement district there may be other local regulations in addition to the others. Check this with the local authority.

10.0 MEASUREMENT

10.1 Firewood Volumes

The sale of firewood to customers can be in any unit that is agreeable between the supplier and the buyer. Traditionally the unit has been the cord which is described in Imperial Units as a pile of stacked wood 4' x 4' x 8' or 128 cubic feet of wood, bark and air space. If the wood is shorter than 4', and it usually is, the cord consists of a number of tiers of 4' high by 8' long. Each tier is called a "face cord" and if the firewood has been cut 12" long the term used for a tier is a "rick". Thus four ricks make a cord. Face cords would obviously contain differing volumes with differing lengths. The most common firewood length for fireplace and space heater use is 16", so 3 tiers 4' x 8' are required for a cord.

The time required to carefully stack a cord of firewood in the back of a truck only to dump the wood in a pile in your customer's driveway seems like a wasted effort. It is extremely important however to ensure your customer gets what he expects in volume delivered. There are techniques for truck loading where consistent volumes can be placed in a truck. This volume can be measured by test stacking a few loads, then relate this volume to the capacity of your truck in cords.



Test stacking a tier of 16" firewood 4' x 8'. Three tiers of wood equals one cord.

10.2 Scaling

Most firewood sales will be in cords or truck loads or some unit other than metric measurements. Most other forest products are sold or measured in metric units—usually a cubic metre.

Payment to contractors for logging may be based on cubic metres and you will probably require conversions from cords to metres and vice-versa for your own budget and cost control. In any case as owner you must report all timber cut from your lands, to the Ministry of Forests, through scale returns.

The Ministry of Forests scaling regulations require monthly scale returns to be submitted on approved forms by official, licenced or acting scalers who have been authorized by the Forest Service regional office. Authorization requires certain conditions, tests and performance to have been met. For authorization to scale minor forest products including firewood from privately owned land, application can be made by you through the scaling department at your nearest Forest Service District office. If you will be scaling more than 300 m³ (119 cords) in the year, there is a fee of \$100 annually.

There are two major documents to be completed for the District office to record your scale returns. These are:

- F.S. 222 – records daily each sale or transaction
- F.S. 72 – records monthly a summary of F.S. 222 records

During months when no scales are recorded it is necessary to submit a "nil" report to the Forest Service on a specified form. Examples of each of these forms are provided in Appendix VII.

With use of the factor 0.7, as stipulated by the Forest Service, a cord of firewood is equivalent to 89.6 cubic feet or 2.53 m³.

There is a \$0.05 per cubic metre administration fee imposed by the Forest Service for processing stumpage and royalty accounts whenever there is a stumpage billing. However, for timber or firewood from private land, this charge is waived unless the volume exceeds 200 m³.

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Victoria, B.C.
V8W 3E7

Tel: 387-5291

Ministry of Environment
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Tel: 387-1161

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Association
Douglas Gook, President
P.O. Box 4321
Quesnel, B.C.

Tel: 747-3363

Workers' Compensation Board
6951 Westminster Hwy
Richmond, B.C.
V7C 1C6

Tel: 273-2266

APPENDIX I
FOREST CLASSIFICATION:
Standard Symbols and Conventions

SOME TREE SPECIES OF BRITISH COLUMBIA

COMMON NAME	SCIENTIFIC NAME	GENUS SYMBOL	SPECIES SYMBOL
Red Alder	<i>Alnus rubra</i>	D	Dr
Amabilis fir	<i>Abies amabilis</i>	B	Ba
Grand fir	<i>Abies grandis</i>	B	Bg
Common paper birch	<i>Betula papyrifera</i>	E	Ep
Western red cedar	<i>Thuja plicata</i>	C	Cw
Yellow cedar	<i>Chamaecyparis nootkatensis</i>	Y	Yc
Douglas-fir	<i>Pseudotsuga menziesii</i>	F	Fd
Western hemlock	<i>Tsuga heterophylla</i>	H	Hw
Western larch	<i>Larix occidentalis</i>	L	Lw
Broadleaved maple	<i>Acer macrophyllum</i>	M	Mb
Lodgepole pine	<i>Pinus contorta</i>	P	Pl
Aspen	<i>Populus tremuloides</i>	A	At
Black cottonwood	<i>Populus balsamifera</i>	A	Ac
Englemann spruce	<i>Picea engelmannii</i>	S	Se
Sitka spruce	<i>Picea sitchensis</i>	S	Ss
White spruce	<i>Picea glauca</i>	S	Sw

CLASSIFICATION SYMBOLS FOR MAP LABELS

Polygon No. _____ 13 .
 Map Label _____ F C (D) 4 3 1 M 7
 Species Composition _____
 Age Class _____
 Height Class _____
 Stocking Class _____
 Site Class _____
 Crown Closure _____

AGE CLASS		HEIGHT CLASS		SITE CLASS		CROWN CLOSURE	
CODE	LIMITS years	CODE	LIMIT metres	CODE	SITE	CODE	LIMIT (%)
1	1 - 20	1	0 - 10.4	L	Low	0	0 - 5
2	21 - 40	2	10.5 - 19.4	P	Poor	1	6 - 15
3	41 - 60	3	19.5 - 28.4	M	Medium	2	16 - 25
4	61 - 80	4	28.5 - 37.4	G	Good	3	26 - 35
5	81 - 100	5	37.5 - 46.4			4	36 - 45
6	101 - 120	6	46.5 - 55.4			5	46 - 55
7	121 - 140	7	55.5 - 64.4			6	56 - 65
8	141 - 250	8	64.5+			7	66 - 75
9	251+					8	76 - 85
						9	86 - 95
						10	96 - 100

For more detail refer to Forest Service Inventory Manual.

STOCKING CLASS CODES

CODE	APPLIES TO	LIMITS NO. TREES
0	all immature	N/A
1	all mature	>76/ha. 27.5 cm+d.b.h.
2	all mature	<76/ha. 27.5 cm+d.b.h.

APPENDIX II
FIREWOOD YIELDS IN CORDS PER HECTARE

TABLE 1
FIREWOOD YIELDS FOR FULLY STOCKED ALDER STANDS,
B.C. COAST

AGE	CORDS PER HECTARE BY LAND QUALITY		
	FAIR	MEDIUM	GOOD
25	31	59	87
30	46	79	112
35	59	98	137
40	73	117	161
45	85	135	184
50	97	152	208
55	109	169	229
60	119	184	251

Source: Chambers, Charles J., FRDA Report No. 115

For natural well stocked stands in coastal B.C. Includes both wood and bark. Does not include trees where the stump would be less than 20 cm (8 inches) in diameter. Does not include the upper part of the stem where the diameter is less than 10 cm (4 inches).

TABLE 2
FIREWOOD YIELDS FOR FULLY STOCKED
DOUGLAS FIR STANDS,
B.C. COAST

AGE	CORDS PER HECTARE BY LAND QUALITY	
	MEDIUM	GOOD
40	59	135
50	113	202
60	158	270
70	196	324
80	225	379
90	253	414
00	283	444
110	301	476
120	319	501

Source: B.C. Ministry of Forests

TABLE 3
FIREWOOD YIELDS FOR FULLY STOCKED
LODGEPOLE PINE STANDS,
INTERIOR B.C.

AGE	CORDS PER HECTARE BY LAND QUALITY	
	MEDIUM	GOOD
40	17	32
50	39	57
60	64	90
70	101	153
80	134	177
90	153	195
100	167	210
110	177	220
120	183	225

Source: B.C. Ministry of Forests

For natural well stocked stands in Interior B.C. Includes both wood and bark. Does not include trees where the stump would be less than 15 cm (6 inches) in diameter. Does not include the upper part of the stem where the diameter is less than 10 cm (4 inches).

TABLE 4
FIREWOOD YIELDS FOR FULLY STOCKED
WHITE SPRUCE STANDS,
INTERIOR B.C.

AGE	CORDS PER HECTARE BY LAND QUALITY	
	MEDIUM	GOOD
40	16	30
50	43	67
60	79	103
70	103	141
80	126	162
90	144	185
100	162	208
110	177	226
120	194	245

Source: B.C. Ministry of Forests

For natural well stocked stands in Interior B.C. Includes both wood and bark. Does not include trees where the stump would be less than 15 cm (6 inches) in diameter. Does not include the upper part of the stem where the diameter is less than 10 cm (4 inches).

Continued...

TABLE 5
FIREWOOD YIELDS FOR FULLY STOCKED ASPEN STANDS
IN B.C.

AGE	CORDS PER HECTARE BY LAND QUALITY			
	POOR	FAIR	MEDIUM	GOOD
30	0	5	13	20
40	4	18	40	55
50	31	48	71	99
60	52	72	100	127
70	66	89	117	147
80	78	101	128	160
90	87	111	137	168
100	93	117	146	174
110	98	121	152	181

Source: FRDA Report No. 124

For natural well stocked stands in B.C. and Alberta. Includes both wood and bark. Does not include trees where the stump would be less than 15 cm (6 inches) in diameter. Does not include the upper part of the stem where the diameter is less than 10 cm (4 inches).

TABLE 6
FIREWOOD YIELDS FOR FULLY STOCKED
SPRUCE-ASPEN STANDS IN B.C.

AGE	CORDS PER HECTARE BY LAND QUALITY							
	POOR		FAIR		MEDIUM		GOOD	
	SPR	ASP	SPR	ASP	SPR	ASP	SPR	ASP
30	0	0	0	5	0	10	0	13
40	0	5	0	18	1	29	2	31
50	0	39	1	45	5	48	13	50
60	1	63	6	66	19	66	35	60
70	6	79	19	77	38	75	63	65
80	17	88	37	83	62	78	91	67
90	34	94	74	86	104	78	137	63
100	50	94	74	86	104	78	137	63
110	63	89	89	82	121	73	152	59
120	75	80	103	73	135	65	165	53

Source: FRDA Report No. 124

For natural well stocked stands in B.C. and Alberta. Includes both wood and bark. Does not include trees where the stump would be less than 15 cm (6 inches) in diameter. Does not include the upper part of the stem where the diameter is less than 10 cm (4 inches).

TABLE 7
ESTIMATED FIREWOOD ROTATIONS FOR B.C. WOODLOTS
(PATCH CLEAR-CUTTING)

SPECIES	AGE IN YEARS BY SITE QUALITY		
	POOR/FAIR	MEDIUM	GOOD
Aspen	75	60	50
Alder	60	50	40
Douglas Fir, Coast	80	65	50
Lodgepole Pine	95	80	70
White Spruce	95	75	65
Hemlock/Balsam, Coast	75	60	50
Douglas Fir, Interior, Wet	90	70	60
Hemlock, Interior	90	70	60
Balsam, Interior	85	65	55

Source: Derived from Ministry of Forests yield tables for naturally regenerated second growth stands and average stand diameter to approximate stem size for firewood.

Based on fully stocked natural stands.

Average stand diameter (D.B.H.) about 15 cm (6 inches) for Poor/Fair, about 20 cm (8 inches) for Medium, and 20 to 30 cm (8 to 10 inches) for Good.

APPENDIX III
EXAMPLES OF TYPES OF PLANS

EXAMPLE OF A DEVELOPMENT PLAN
DEVELOPMENT PLANS - BLOCK 1
DAISY CREEK WOODLOT

Block No.	Year	Cutting Area	Type	Area ha	VOLUME BY SPECIES M ³					TOTAL	Product Activity
					Fir	Cedar	Pine	Alder	Maple		
1	1	5	F440M6	0.9	107.1	12.6	0	12.6	0	132.3	thinning @ 35%
		4	FD330M7	1.0	0.0	0.0	0	70.0	0	70.0	Selection alder only
		3	DMbF330G7	2.4	144.0	48.0	0	456.0	168	816.0	Clearcut
Total year	1			4.3	251.1	60.6	0	538.6	168	1018.3	
	2	5	F440M6	0.9	107.1	12.6	0	12.6	0	132.3	thinning @ 35%
		4	FD330M7	1.0	0.0	0.0	0	70.0	0	70.0	Selection alder only
		3	DMbF330G7	2.3	138.0	46.0	0	437.0	161	782.0	Clearcut
Total year	2			4.2	245.1	58.6	0	519.6	161	984.3	
	3	5	F440M6	0.9	107.1	12.6	0	12.6	0	132.3	thinning @ 35%
		4	FD330M7	0.7	0.0	0.0	0	49.0	0	49.0	Selection alder only
		3	DMbF330G7	2.4	144.0	48.0	0	456.0	168	816.0	Clearcut
Total year	3			4.0	251.1	60.6	0	517.6	168	997.3	
	4	5	F440M6	0.9	107.1	12.6	0	12.6	0	132.3	thinning @ 35%
		1	FD330M7	1.0	0.0	0.0	0	70.0	0	70.0	Selection alder only
		3	DMbF330G7	2.4	144.0	48.0	0	456.0	168	816.0	Clearcut
Total year	4			4.3	251.1	60.6	0	538.6	168	1018.3	
	5	5	F440M6	0.3	35.7	4.2	0	4.2	0	44.1	thinning @ 35%
		1	FD330M7	1.9	0.0	0.0	0	133.0	0	133.0	Selection alder only
		3	DMbF330G7	0.0	0.0	0.0	0	0.0	0	0.0	Clearcut
		2	FPI430M7	3.4	612.0	0.0	204	0.0	0	816.0	Clearcut
Total year	5			5.6	647.7	4.2	204	137.2	0	993.1	
TOTAL Years 1-5		5	F440M6	3.9	464.1	54.6	0	54.6	0	573.3	thinning @ 35%
		4	FD330M7	2.7	0.0	0.0	0	189.0	0	189.0	Selection alder only
		3	DMbF330G7	9.5	570.0	190.0	0	1805.0	665	3230.0	Clearcut
		1	FD330M7	2.9	0.0	0.0	0	203.0	0	203.0	Selection alder only
	2	FPI430M7	3.4	612.0	0.0	204	0.0	0	816.0	Clearcut	
TOTAL - Block 1				22.4	1646.1	244.6	204	2251.6	665	5011.3	

**DEVELOPMENT PLAN
VOLUME REMAINING AFTER YEAR 5 – BLOCK 1**

TYPE	INITIAL AREA (ha)	LOGGED YEAR 1-5	BALANCE (ha)	BALANCE TIMBER (m ³)	ACTIVITY
1	2.9	2.9	0.0	609.0	Selection alder only
2	3.9	3.4	0.5	120.0	Clearcut
3	9.5	9.5	0.0	0.0	Clearcut
4	2.7	2.7	0.0	567.0	Selection alder only
5	3.9	3.9	0.0	1064.7	Thinning @35%
6	0.5	0.0	0.5	150.0	No activity
TOTAL	23.4	22.4	1.0	2510.7	

**DEVELOPMENT PLAN—ROADS AND BRIDGES
DAISY CREEK WOODLOT**

BLOCK NO.	YEAR	CUTTING AREA	ROAD NAME	DISTANCE METRES	BRIDGES	LANDINGS	COST TOTAL (\$)
1	1	3,4,5	D200	100.0			2,000
			D201	320.0		2	5,100
Total Year 1	1			420	0	2	7,100
	2	3,4,5	D200	300	1	2	7,700
Total Year 2			D100	200		1	4,150
				500	1	3	11,850
Total Year 3	3	3,4,5	D100	420		2	8,400
Total Year 4	4	1,3,5	D202	130		1	2,425
Total Year 5	5	1,2,3,5	D101	250		1	4,525
Total Years 1-5				1720	1	9	34,300

**DEVELOPMENT PLAN-FORESTRY ACTIVITY
DAISY CREEK WOODLOT**

BLOCK NO.	YEAR	CUTTINGS AREA	SITE PREPARATION area(ha)	PLANTING		BRUSH & WEED		COST \$	TOTAL EXPENSE \$
				COST \$	area ha	COST \$	area ha		
1	1	3	2.4	480	2.4	1080			1560
	2	3	2.3	460	2.3	1035			1495
	3	3	2.4	480	2.4	1080	2.4	360	1920
	4	3	2.4	480	2.4	1080	2.3	345	1905
	5	3.2	3.4	170	3.4	1530	2.4	360	2060
Total			12.9	2070	12.9	5805	7.1	1065	8940

Continued...

ANNUAL PLAN (BUDGET) DAISY CREEK WOODLOT

SECTION	ITEM	MONTH		FEBRUARY		MARCH		APRIL		MAY	
		JANUARY		FEBRUARY		MARCH		APRIL		MAY	
		Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost
A	ACTIVITIES										
	Forestry (ha)										
	Road Ldg. Bridge (m)			150 m		150 m		120 m			
	Harvesting m ³					110 m ³		110 m ³		110 m ³	
	Processing cords					10		40		40	
	Delivery cords					40		40		40	
	TOTAL										
B COST	EQUIPMENT										
	Capital Purch										
	Major repairs		2500								
	op. & Mtc.			800		1100		600		400	
	contracted			1000		1000		400			
	op. supplies			200		300		200		200	
	TOTAL		2500	2000		2400		1200		600	
C	LABOR										
	Forestry										
	Road/Ldg/Bridge			10	1000	10	1000	4	400		
	Harvesting					3	300	3	300	3	300
	Processing					2	200	6	600	6	600
	Delivery							6	600	6	600
	TOTAL			10	1000	15	1500	19	1900	15	1500
D	OVERHEAD										
	labor burden				100		150		190		150
	office		100		100		100		100		100
	insurance		1000								
	account/legal										
	interest		0		0		40		40		0
	TOTAL		1100		200		290		330		0 250
E	REVENUES										
	firewood							40	4000	40	4000

ANNUAL PLAN (BUDGET) DAISY CREEK WOODLOT (CONTINUED...)

JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		TOTAL	
Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost	Unit m.d. or vol.	Cost
110m ³		110 m ³		110 m ³		110 m ³		110 m ³		2.4 ha.		2.4		2.4ha	
40		40		40		50		50		18		18.3		1018.3 m ³	
40		45		45		50		50		50		47		407 cords	
														407 cords	
															2500
	400		400		400		400		300		200		200		5200
															2400
	200		200		200		200		300		300		840		3140
	600		600		600		600		600		500		1040		13240
											480		240		720
															2400
3	300	3	300	3	300	3	300	3	300	2	200	2	200		2800
6	600	6	600	6	600	6	600	8	800	8	800	8	800		6200
6	600	6	600	6	600	6	600	7	700	7	700	7	700		5700
15	1500	15	1500	15	1500	15	1500	18	1800	17	2180	17	1940	167	17820
	150		150		150		150		180		218		194		1782
	100		100		100		100		100		100		100		1200
			600												1000
	0		0		0		0		0		0		0		600
0	250	0	850	0	250	0	250	0	280	0	318	0	294		80
															4662
40	4000	45	4500	45	4500	50	5000	50	5000	50	5000	47	4700	407	40700

Continued..

Appendix III Continued...

CASH FLOW FORECAST - DAISY CREEK WOODLOT

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Cash in bank Beginning of Month	10,000	6,400	3,200	(990)	(420)	1,230	2,880	4,430	6,580	9,230	11,550	13,552	
Money Spent													
Equipment	2,500	2,000	2,400	1,200	600	600	600	600	600	600	500	1,040	13,240
Labor	0	1,000	1,500	1,900	1,500	1,500	1,500	1,500	1,500	1,800	2,180	1,940	17,820
Overhead	1,100	200	290	330	250	250	850	250	250	280	318	294	4,662
Total	3,600	3,200	4,190	3,430	2,350	2,350	2,950	2,350	2,350	2,680	2,998	3,274	35,722
Revenue	0	0	0	4,000	4,000	4,000	4,500	4,500	5,000	5,000	5,000	4,700	40,700
Net Cash Flow	(3,600)	(3,200)	(4,190)	570	1,650	1,650	1,550	2,150	2,650	2,320	2,002	1,426	
Cash in Bank End of Month	6,400	3,200	(990)	(420)	1,230	2,880	4,430	6,580	9,230	11,550	13,552	14,978	

APPENDIX IV
MAJOR MANAGEMENT AND SILVICULTURE
CONSIDERATIONS OF B.C. SPECIES

TABLE 1
MAJOR MANAGEMENT AND SILVICULTURAL
CONSIDERATIONS FOR B.C. WOODLOT SPECIES

Species	Management Regime	Harvesting Technique	Growth Rate	Shade Tolerance	Regeneration Technique or Condition
Aspen	even aged	clear cut	fast	very intolerant	Sprouts. Expose ground to heat and light.
Red Alder	even aged	clear cut	fast	intolerant	Seed from close or distant adjacent trees. Expose mineral soil
Douglas Fir - Dry Climate	all aged	selection	medium	mildly tolerant	Seed from close-by upwind stand or leave seed trees or plant
- Wet Climate	even aged	clear cut	medium	mildly intolerant	
White Spruce	all aged	selection	slow	tolerant	Seed in from adjacent trees or plant openings.
Lodgepole Pine	even aged	clear cut	medium	intolerant	Seed from slash or plant. Expose cones to summer heat.

Source: U.S.D.A. Ag. Handbook #217; B.C. Forestry Handbook.

APPENDIX V
CONVERSION FACTORS TO CONVERT SOLID WOOD
IN TREE VOLUME TABLES
TO VOLUMES OF WOOD PLUS BARK

TABLE 1
CONVERSION FACTORS TO CONVERT SOLID WOOD IN
TREE VOLUME TABLES TO VOLUMES OF WOOD PLUS BARK

SPECIES	YOUNG TREES (Pulpwood & Firewood) (multiply solid wood times factor)	OLDER TREES (Sawlogs)
Alder	1.13	1.16
Aspen	1.18	1.20
Cottonwood	1.19	1.22
Maple	1.10	1.12
Birch	1.16	1.19
Coast Balsam	1.11	1.13
Interior Balsam	1.13	1.16
Coast Douglas Fir	1.18	1.28
Interior Douglas Fir	1.20	1.30
Coast Hemlock	1.16	1.19
Interior Hemlock	1.19	1.22
Lodgepole Pine	1.10	1.11
White Spruce	1.12	1.15

Bark thickness varies with the age of the tree and with location (height) on the tree.

Source: Derived by Nawitka Consultants, Victoria, on the basis of data from Dobie and Wright, 1975, Smith and Kozak, 1967, and Nawitka file data on destructive sampling for biomass estimates in B.C. (ENFOR Program).

Application example: To convert Ministry of Forests Volume tables (giving volume in m³ inside bark), multiply the volume by the appropriate factor taken from the table above and then divide by 2.4 to convert m³ to cords of wood and bark.

APPENDIX VII
EXAMPLES OF SCALE RETURN FORMS
REQUIRED BY THE B.C. FOREST SERVICE



Province of British Columbia Ministry of Forests and Lands

332507

RECORD OF PURCHASE OF SPECIAL FOREST PRODUCTS
 PLACE: 17 P Nanaimo DATE: Sept 2 1990 Timber Mark: 1X3

PURCHASER: Woodlot Management VENDOR: DASY CREEK WOODLOT

DESCRIPTION	LENGTH OR SQUARES	WIDTH OR BUNDLES	HEIGHT OR PIECES	FACTOR	METRES ³
firewood	5.5	1.2	2.4	.7	11.4
AMOUNT OF STUMPAGE AND/OR ROYALTY COLLECTED					
SIGNATURE OF DEALER: <u>JJ Smith</u>			SIGNATURE OF VENDOR OR AGENT: <u>JJ Smith</u>		
ADDRESS OF PURCHASER:			ADDRESS OF VENDOR: <u>Loffhouse Rd, Cedar B.C.</u>		

ORIGINAL - TO BE GIVEN TO VENDOR AND RETAINED BY HIM.



Province of British Columbia Ministry of Forests and Lands

332506

RECORD OF PURCHASE OF SPECIAL FOREST PRODUCTS
 PLACE: 17P Nanaimo DATE: Sept 12 1990 Timber Mark: 1X3

PURCHASER: Woodlot Management VENDOR: DASY CREEK WOODLOT

DESCRIPTION	LENGTH OR SQUARES	WIDTH OR BUNDLES	HEIGHT OR PIECES	FACTOR	METRES ³
firewood	12.8	1.2	2.4	.7	26.6
AMOUNT OF STUMPAGE AND/OR ROYALTY COLLECTED					
SIGNATURE OF DEALER: <u>JJ Smith</u>			SIGNATURE OF VENDOR OR AGENT: <u>JJ Smith</u>		
ADDRESS OF PURCHASER:			ADDRESS OF VENDOR: <u>Loffhouse Rd, Cedar B.C.</u>		

ORIGINAL - TO BE GIVEN TO VENDOR AND RETAINED BY HIM.

These records are summarized on the Summary of Scale (page 91).

APPENDIX VIII

MEASUREMENT AND CONVERSION FACTORS

	METRIC	IMPERIAL	METRIC	IMPERIAL
LENGTH	1 cm (centimetre)	= 0.394 inch	2.54 cm	= 1 inch
	1 km (kilometre)	= 0.621 mile	1.609 Km	= 1 mile
	1 m (metre)	= 3.281 feet	0.305m	= 1 foot
AREA	1 ha (hectare)	= 2.471 acres	0.405 ha	= 1 acre
	1 m ² (square metre)	= 10.764 sq ft	0.093 m ²	= 1 sq ft
	1 km ² (square km)	= 0.386 sq miles	2.590 km ²	= 1 sq mile
VOLUME	1 l (litre)	= 0.220 gallon	4.546 l	= 1 gallon
	1 m ³ (cubic metre)	= 35.315 cubic ft	0.028m ³	= 1 cubic ft
	1 m ³ (cubic metre)	= 0.353 cunits	2.832 m ³	= 1 cunit (100 ft ³ of solid wood)
WEIGHT	1 g (gram)	= 0.035 ounce	28.349 g	= 1 ounce
	1 Kg (kilogram)	= 2.205 pounds	0.454 Kg	= 1 pound
	1 t (tonne)	= 1.102 tons (of 2000 lbs)	0.907 t	= 1 ton (2000 lbs)

RATIOS 1 km/l (kilometre per litre) = 2.825 miles per gallon

0.354 km/l = 1 mile per gallon

1 m²/ha (square metre per hectare) = 4.356 square ft per acre

0.230 m²/ha = 1 sq ft per acre

1 m³/ha (cubic metre per hectare) = 14.291 cubic feet per acre

0.070 m³/ha = 1 cubic ft per acre

1 t /ha (tonne per hectare) = 0.446 ton (of 2000 lb) per acre

2.242 t /ha = 1 ton (2000 lb) per acre

1 cord = stacked pile of wood, bark and air that is 4 feet high,
4 feet wide and 8 feet long

= 128 cubic feet of stacked wood, bark and air

= 3.6 m³ of stacked wood, bark and air

= approx. 85 cubic feet* of solid wood and bark

= approx. 2.4 m³* of solid wood and bark

RULE OF THUMB: A 3/4 ton pick-up truck will hold 3/4 of a cord stacked, or half a cord if the pieces thrown in at random

Source: Metric conversion factors taken from Bowen, Murry G., Selected metric (SI) units and conversion factors for Canadian forestry, Forest Management Institute, CFS, Ottawa, August 1974

NOTE: The Ministry of Forests has adopted for its official conversion rate a ratio of 2.5 m³ per cord (89 cubic feet per cord).